5. Surface Water, Groundwater, and Sediments

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Abstract

The 1999 surface water and runoff analysis results are generally consistent with past findings. We collected runoff samples using automated samplers; the samplers are actuated when a significant precipitation event causes flow in a drainage crossing the boundaries of Los Alamos National Laboratory (LANL or the Laboratory). Sixteen gross alpha measurements and one gross beta measurement exceeded the Department of Energy (DOE) derived concentration guides (DCG) for public dose in runoff samples in 1999. These samples came from Cañada del Buey, Ancho and Los Alamos Canyons and from around Area G, the Laboratory's low-level radioactive waste disposal facility. We use DCGs to screen runoff samples for cases of larger contaminant transport rather than to evaluate health risk. The DOE DCGs for public dose are determined assuming that two liters per day of water are consumed each year. Runoff, however, is present only a few days each year, and is not used for drinking water.

In 1998, LANL found high-explosives constituents in the regional aquifer at Technical Area (TA) 16 in the southwest portion of the Laboratory at concentrations above the Environment Protection Agency (EPA) Health Advisory guidance values for drinking water. Continued testing of water supply wells in 1999 showed that these compounds are not present in Los Alamos County drinking water. Other groundwater samples from the regional aquifer were consistent with previous results. Trace levels of tritium are present in the regional aquifer in a few areas where liquid waste discharges occurred, notably beneath Los Alamos, Pueblo, and Mortandad Canyons. The highest tritium level found in a regional aquifer test well is about 2% of the drinking water standard. Nitrate concentrations in a test well beneath Pueblo Canyon remain elevated, but in 1999, they were only about half the drinking water standard. In 1999, we detected no radionuclides other than naturally occurring uranium in Los Alamos County or San Ildefonso Pueblo water supply wells.

Analytical results for alluvial and intermediate depth groundwater are similar to those of past years. Waters near former or present effluent discharge points show the effects of these discharges. No samples exceeded DOE DCGs for public exposure. Alluvial groundwater samples in Los Alamos and Mortandad Canyons exceeded DOE DCGs for a DOE-operated drinking water system. The constituents exceeding drinking water DCGs were gross beta and americium-241. Alluvial groundwater is not used for drinking water.

The 1999 sediment sampling analysis is generally consistent with historical data. Plutonium occurs above fallout levels in Pueblo and Los Alamos Canyons and extends off-site from the Laboratory. Within Mortandad Canyon, the greatest radionuclide levels in sediments are found between the point where Radioactive Liquid Waste Treatment Facility (RLWTF) effluent enters the drainage and the sediment traps, approximately a 3-km distance. Radionuclide levels near or slightly exceeding background levels are found downstream of the sediment traps, extending to the Laboratory/San Ildefonso Pueblo boundary. A number of sediment samples near and downstream of the TA-54 Solid Waste Operations at Area G contained plutonium-238 at activities greater than background. We also found above background levels of plutonium and americium in sediments downstream of Area AB.

No high explosives or other organic compounds were detected at any of the surface water, runoff, sediment, or groundwater stations discussed here.

The 1999 strontium-90 data LANL collected in sediments, surface water, and groundwater are not valid because the analytical laboratory failed to properly apply the analytical technique. The data at every location for 1999 are questionable, and this represents the loss of an entire year's monitoring data for strontium-90. We present the data in this report for documentary purposes only. If taken at face value, the 1999 strontium-90 values would indicate unusually high levels in sediments, surface water, and groundwater. LANL has resolved the analytical laboratory problems and will continue monitoring strontium-90 at all locations in 2000. In 1999, the New

Mexico Environment Department (NMED) collected split samples at many wells where LANL data appeared to show unusually high strontium-90 values. NMED samples show only one detection of strontium-90, supporting our conclusion that the 1999 strontium-90 data are not valid.

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A. Description of Monitoring Program

Studies related to development of groundwater supplies began at Los Alamos in 1945 under the direction of the US Geological Survey (USGS). Studies specifically aimed at environmental monitoring and protecting groundwater quality were initiated as joint efforts between the Atomic Energy Commission, the Los Alamos Scientific Laboratory, and the USGS in about 1949. These initial efforts focused on Pueblo and DP/Los Alamos Canyons, which received radioactive industrial waste discharges in the early days of the Laboratory.

The current network of annual sampling stations for surface water and sediment surveillance includes a set of regional (or background) stations and a group of stations near or within the Los Alamos National Laboratory (LANL or the Laboratory) boundary. The regional stations establish the background quantities of radionuclides and radioactivity derived from natural minerals and from fallout affecting northern New Mexico and southern Colorado.

Groundwater samples are taken from wells and springs within or adjacent to the Laboratory and from the nearby San Ildefonso Pueblo. The on-site stations, for the most part, focus on areas of present or former radioactive waste disposal operations, such as canyons (Figure 1-3). To provide context for discussion of monitoring results, the setting and operational history of currently monitored canyons that have received radioactive or other liquid discharges are briefly summarized below.

For a discussion of sampling procedures, analytical procedures, data management, and quality assurance, see Section F below.

1. Acid Canyon, Pueblo Canyon, and Lower Los Alamos Canyon

Acid Canyon, a small tributary of Pueblo Canyon, was the original disposal site for liquid wastes generated by research on nuclear materials for the World War II Manhattan Engineer District atomic bomb project. Acid Canyon received untreated radioactive industrial effluent from 1943 to 1951. The Technical Area (TA) 45 treatment plant was completed in 1951, and from 1951 to 1964 the plant discharged treated effluents that contained residual radionuclides into nearby Acid Canyon. Several decontamination projects have removed contamination from the area, but remaining residual radioactivity from these releases is now associated with the sediments in Pueblo Canyon (ESP 1981).

The inventory of radioactivity remaining in the Pueblo Canyon system is only approximately known. Several studies (ESP 1981, Ferenbaugh et al., 1994) have concluded that the plutonium in this canyon system does not present a health risk to the public. Based on analysis of radiological sediment survey data, the estimated total plutonium inventory in Acid Canyon, Pueblo Canyon, and Lower Los Alamos Canyon ranges from 246 mCi to 630 ± 300 mCi (ESP 1981). The estimated plutonium releases were about 177 mCi, in satisfactory agreement with the measured inventory considering uncertainties in sampling and release estimates. About two-thirds of this total is in the Department of Energy (DOE)-owned portion of lower Pueblo Canyon.

Pueblo Canyon currently receives treated sanitary effluent from the Los Alamos County Bayo Sewage Treatment Plant in the middle reach of Pueblo Canyon. Water occurs seasonally in the alluvium, depending on the volume of surface flow from snowmelt, thunderstorm runoff, and sanitary effluents. Tritium, nitrate, and chloride, apparently derived from these industrial and municipal disposal operations, have infiltrated to the intermediate perched ground water (at depths of 37 to 58 m [120 to 190 ft]) and to the regional aquifer (at a depth of 180 m [590 ft]) beneath the lower reach of Pueblo Canyon. Except for occasional nitrate values, levels of these constituents are a small fraction of the EPA drinking water standards.

Starting in 1990, increased discharge of sanitary effluent from the county treatment plant resulted in nearly continual flow during most months except June and July in the lower reach of Pueblo Canyon and across DOE land into the lower reach of Los Alamos Canyon on San Ildefonso Pueblo land. From mid-June through early August, higher evapotranspiration and the diversion of sanitary effluent for golf course irrigation eliminate flow from Pueblo Canyon into Los Alamos Canyon. Hamilton Bend Spring, which in the past discharged from alluvium in the lower reach of Pueblo Canyon, has been dry since 1990, probably because there was no upstream discharge from the older, abandoned Los Alamos County Pueblo Sewage Treatment Plant. Farther east, the alluvium is continuously saturated, mainly because of infiltration of effluent from the Los Alamos County Bayo Sewage Treatment Plant. Effluent flow from Pueblo Canyon into Los Alamos Canyon generally extends to somewhere between the DOE/San Ildefonso Pueblo boundary and the confluence of Guaje and Los Alamos Canyons.

2. DP Canyon and Los Alamos Canyon

In the past, Los Alamos Canyon received treated and untreated industrial effluents containing some radionuclides. The upper reach of Los Alamos Canyon experienced releases of treated and untreated radioactive effluents during the earliest Manhattan Project operations at TA-1 (1942–1945) and some release of water and radionuclides from the research reactors at TA-2. An industrial liquid waste treatment plant that served the old plutonium processing facility at TA-21 discharged effluent containing radionuclides into DP Canyon, a tributary to Los Alamos Canyon, from 1952 to 1986. Los Alamos Canyon also received discharges containing radionuclides from the sanitary sewage lagoon system at the Los Alamos Neutron Science Center (LANSCE) at TA-53. The low-level radioactive waste stream was separated from the sanitary system at TA-53 in 1989 and directed into a total retention evaporation lagoon.

The reach of Los Alamos Canyon within the Laboratory boundary presently carries flow from the Los Alamos Reservoir (west of the Laboratory) as well as National Pollutant Discharge Elimination System (NPDES)-permitted effluents from TA-53 and TA-21. Infiltration of effluents and natural runoff from the stream channel maintains a shallow body of groundwater in the alluvium of Los Alamos Canyon within the Laboratory boundary west of State Road 4. Groundwater levels are highest in late spring from snowmelt runoff and in late summer from thundershowers. Water levels decline during the winter and early summer when runoff is at a minimum. Groundwater also occurs within alluvium in the lower portion of Los Alamos Canyon on San Ildefonso Pueblo lands.

3. Sandia Canyon

Sandia Canyon has a small drainage area that heads at TA-3. The canyon receives water from the cooling tower at the TA-3 power plant. Treated effluents from the TA-46 Sanitary Wastewater Systems (SWS) Facility are rerouted to Sandia Canyon. These effluents support a continuous flow in a short reach of the upper part of the canyon. Only during summer thundershowers does stream flow approach the Laboratory boundary at State Road 4, and only during periods of heavy thunderstorms or snowmelt does surface flow extend beyond the Laboratory boundary.

4. Mortandad Canyon

Mortandad Canyon has a small drainage area that heads at TA-3. Its drainage area receives inflow from natural precipitation and a number of NPDES outfalls, including one from the RLWTF at TA-50. The TA-50 facility began operations in 1963. The effluents infiltrate into the stream channel and maintain a saturated zone in the alluvium extending about 3.5 km (2.2 mi) downstream from the outfall. The easternmost extent of saturation remains on-site, ending about 1.6 km (1 mi) west of the Laboratory boundary with San Ildefonso Pueblo. Over the period of operation, the radionuclides in the Radioactive Liquid Waste Treatment Facility (RLWTF) effluent have often exceeded the DOE DCGs for public dose. The effluent also contains nitrate that has caused alluvial groundwater concentrations to exceed the New Mexico groundwater standard of 10 mg/L (nitrate as nitrogen). In 1999, the new reverse osmosis and ultrafiltration system at the RLWTF began operation. This system removes additional radionuclides and nitrate from the effluent, and discharges from the plant now meet the DOE public dose DCGs and the New Mexico groundwater standard for nitrate.

Continuous surface flow across the drainage has not reached the San Ildefonso Pueblo boundary since observations began in the early 1960s (Stoker et al., 1991). Three sediment traps located about 3 km (2 mi) downstream from the effluent discharge in Mortandad Canyon dissipate the energy of major thunderstorm runoff events and settle out transported sediments. From the sediment traps, it is approximately 2.3 km (1.4 mi) downstream to the Laboratory boundary with San Ildefonso Pueblo.

The alluvium is less than 1.5 m thick in the upper reach of Mortandad Canyon and thickens to about 23 m at the easternmost extent of saturation. The saturated portion of the alluvium is perched on weathered and unweathered tuff, generally with no more than 3 m of saturation. There is considerable seasonal variation in saturated thickness, depending on the amount of runoff experienced in any given year (Stoker et al., 1991). Velocity of water movement in the alluvium ranges from 18 m/day in the upper reach to about 2 m/day in the lower reach of the canyon (Purtymun 1974; Purtymun et al., 1983). The high turnover rate for water in the alluvial groundwater prevents accumulation of chemicals from the RLWTF effluent (Purtymun et al., 1977). The top of the regional aquifer is about 290 m below the alluvial groundwater.

5. Pajarito Canyon

In Pajarito Canyon, water in the alluvium is perched on the underlying tuff and is recharged mainly through snowmelt and thunderstorm runoff. Saturated alluvium does not extend beyond the facility boundary. Three shallow observation wells were constructed in 1985 as part of a compliance agreement with the State of New Mexico to determine whether technical areas in the canyon or solid waste disposal activities on the adjacent mesa were affecting the quality of shallow groundwater. No effects were observed; the alluvial groundwater is contained in the canyon bottom and does not extend under the mesa (Devaurs 1985).

6. Cañada del Buey

Cañada del Buey contains a shallow alluvial groundwater system of limited extent. The thickness of the alluvium ranges from 1.2 to 5 m, but the underlying weathered tuff ranges in thickness from 3.7 to 12 m. In 1992, saturation was found within only a 0.8-km-long segment, and only two observation wells have ever contained water (ESP 1994). Because treated effluent from the Laboratory's SWS Facility may at some time be discharged into the Cañada del Buey drainage system, a network of five shallow groundwater monitoring wells and two moisture monitoring holes was installed during the early summer of 1992 within the upper and middle reaches of the drainage (ESP 1994). Construction of the SWS Facility was completed in late 1992.

B. Surface Water Sampling

1. Introduction

The Laboratory monitors surface waters from regional and Pajarito Plateau stations to evaluate the environmental effects of its operations. No perennial surface water flows extend completely across the Laboratory in any canyon. Periodic natural surface runoff occurs in two modes: (1) spring snowmelt runoff that occurs over days to weeks at a low discharge rate and sediment load and (2) summer runoff from thunderstorms that occurs over hours at a high discharge rate and sediment load. The surface water within the Laboratory is not a source of municipal, industrial, or irrigation water, though wildlife does use the waters. Activities of radionuclides in surface water samples may be compared to either the DOE Derived Concentration Guides (DCGs) or the New Mexico Water Quality Control Commission (NMWQCC) stream standards, which in turn reference the New Mexico Environment Department's (NMED's) New Mexico Radiation Protection Regulations (Part 4, Appendix A). However, New Mexico radiation protection activity levels are in general two orders of magnitude greater than the DOE DCGs for public dose, so we will discuss only the DCGs here. The concentrations of nonradioactive constituents may be compared with the NMWQCC General, Livestock Watering, and Wildlife Habitat standards. The NMWQCC groundwater standards can also be applied in cases where groundwater outflow may affect stream water quality. Appendix A presents information on these standards.

2. Monitoring Network

We collect surface water samples from Pajarito Plateau stations near the Laboratory and from regional stations. We take surface water grab samples annually from locations where effluent discharges or natural runoff maintains stream flow. Runoff samples have historically been collected as grab samples from usually dry portions of drainages during or shortly after runoff events. As of 1996, we collect runoff samples using stream gaging stations, some with automated samplers (Shaull et al., 1996). Samples are collected when a significant rainfall event causes flow in a monitored portion of a drainage. Many runoff stations are located where drainages cross the Laboratory's boundaries.

We collect regional surface water samples (Figure 5-1) from stations on the Rio Grande, Rio Chama, and Jemez River. These waters provide background data from areas beyond the Laboratory boundary.

Figures 5-2, 5-3, and 5-4 show surface water monitoring stations located on the Pajarito Plateau. We use samples from the stations to monitor water quality effects of potential contaminant sources such as industrial outfalls or soil contamination sites.

3. Radiochemical Analytical Results

Table 5-1 lists the results of radiochemical analyses for surface water and runoff samples for 1999. As discussed in Section 5.F, the analytical laboratory had data quality problems with analysis of strontium-90 for 1999. Therefore, the strontium-90 data appear in a separate table, Table 5-2. To emphasize values that are detections, Tables 5-3 and 5-4 list radionuclides detected in surface water and runoff samples. Detections are defined as values exceeding both the analytical method detection limit and three times the individual measurement uncertainty. The analytical laboratory determined analysis-specific detection limits for many radiochemical measurements in 1999; see Tables 5-3 and 5-4. Individual detection limits were not provided for gross alpha, gross beta, or uranium. Because uranium, gross alpha, and gross beta are almost always detected, we indicate in Table 5-3 only occurrences of these measurements above threshold values. The specific levels are 5 µg/L for uranium, 5 pCi/L for gross alpha, and 20 pCi/L for gross beta and are lower than the Environmental Protection Agency (EPA) maximum contaminant levels (MCLs) or screening levels.

The righthand columns of Tables 5-3 and 5-4 indicate radiochemical detections that are greater than 1/25 of the DOE DCGs for public dose for ingestion of environmental water (1/25 of the DOE DCG for public dose is the DOE drinking water system DCG). The EPA drinking water limits for gross alpha and gross beta values are higher than 1/25 of the DOE public dose DCG (that is, greater than the DOE drinking water system DCGs), so we use the EPA values to screen gross alpha and gross beta values. The DOE public dose DCG value for gross beta is actually the strontium-90 DCG, and the DCG for gross alpha is the plutonium-239, -240 DCG. We chose DCGs because the isotopes represented had the lowest DCGs for alpha and beta emitters. Bear in mind that surface waters on the Laboratory are not used for drinking water.

Runoff samples have high turbidity and present special analysis and interpretation problems. Drinking water is generally low in turbidity, so measurements reflect mainly dissolved constituents, rather than those associated with sediments. We use the DOE DCGs for public dose to screen runoff samples for cases of larger contaminant transport rather than to evaluate health risk. The DCGs are determined assuming that 2 liters of water per day are consumed each year. Runoff, however, is present only a few days each year, and is not used for drinking water. Runoff samples frequently contain high levels of suspended solids (exceeding 25,000 mg/L). The analytical uncertainties associated with measurement of gross alpha and beta levels in samples with high suspended solids are probably greater than reported on the accompanying tables. Because of these large uncertainties, the high gross alpha and beta values may have low precision. The higher than reported uncertainties are results of the analytical process. Gross alpha and beta counting uses a small portion of the sample so the counted sample does not shield alpha or beta emissions from reaching the detector. In samples with high suspended solids, very little sample volume is used. The measured concentration is then extrapolated to a 1-liter volume. Because the sample is not homogeneous, it is unlikely that a small portion of a runoff sample will represent the concentration of constituents in the total sample.

Sixteen gross alpha measurements and one gross beta measurement exceeded the DOE public dose DCG values in runoff samples in 1999. We have not been able to tie these measurements to particular radionuclides; the radionuclides measured in the samples do not account for the gross alpha and gross beta measurements. Other radionuclides present, such as naturally occurring potassium-40, may account for a significant portion of the gross alpha and beta measurements, for example. The gross alpha samples were from Area G stations G-SWMS-2, G-SWMS-3, G-SWMS-4, G-SWMS-5, and G-SWMS-6 and Cañada del Buey at White Rock, DP Canyon near Los Alamos, and Los Alamos Canyon near Los Alamos. Gross beta exceeded the DCG at Ancho Canyon at TA-39. Stations with values greater than half the DCG were gross alpha from the surface water sample at Mortandad Canyon at GS-1 and runoff samples from G-SWMS-4, Sandia Canyon below the Power Plant, Sandia Canyon at Roads and Grounds, and Los Alamos Canyon near Los Alamos. Gross beta measurements more than half the DCG occurred at Ancho Canyon near Bandelier and G-SWMS-3, whereas plutonium-239, -240 at Los Alamos Canyon near Los Alamos and americium-241 at G-SWMS-4 were greater than half the DCG.

Except for strontium-90, most of the measurements at or above detection limits are from locations with previously known contamination: the perimeter of Area G, Acid/Pueblo Canyon, DP/Los Alamos Canyon, and Mortandad Canyon. A few of the measurements at or above detection limits were from locations that do not typically show detectable activity. Detections from locations outside the known contaminated areas near TA-54, Area G, and in Pueblo, DP/Los Alamos, and Mortandad Canyons are discussed below.

a. Radiochemical Analytical Results for Surface Water. Several regional and perimeter stations had detections of radiochemical parameters with no apparent source. Rio Chama at Chamita showed two detections of americium-241. Numerous other surface water, runoff, and groundwater samples had detections of americium-241 at about these levels, as did two de-ionized water (DI) blanks. The Jemez River also showed a detection of americium-241. See Section 5.F.3 for a discussion of radiochemical quality control (QC) results. Several stations showed detections of gross gamma: two samples from the Rio Grande at Otowi (the upper station is outside the influence of runoff from LANL), Frijoles at Rio Grande, and the Jemez River station.

Station SCS-3 in Sandia Canyon showed a detection of plutonium-238. No apparent source exists in Sandia Canyon for this radioactivity.

Three surface water stations (Pueblo 1, Mortandad at GS-1, and Los Alamos Canyon Reservoir) exceeded the EPA MCL of 8 pCi/L for strontium-90 in drinking water. Only Mortandad at GS-1 has shown values of this size previously, so the other two values likely reflect analytical problems.

b. Radiochemical Analytical Results for Runoff. Automated samplers collected runoff samples whenever rainfall events caused significant runoff at these stations. See Section 5.F.1 for a description of the runoff samplers and sampling protocols.

The radionuclides we measured in our analyses did not account for the high gross alpha and gross beta readings from runoff samples, suggesting that additional radionuclides may be present. Alternatively, the methodology for measuring gross alpha and beta may have problems as discussed above.

At station Los Alamos Canyon near Los Alamos (LA), runoff contained cesium-137, americium-241, plutonium-239, -240, plutonium-238, gross alpha and beta, and uranium. LA Canyon below TA-2 had americium-241, plutonium-239, -240, and plutonium-238. DP Canyon near LA had cesium-137, americium-241, plutonium-239, -240, plutonium-238, and gross alpha, beta, and gamma. For Los Alamos Canyon near Los Alamos, values were similar to those seen in 1997 and 1998, though uranium and plutonium values are somewhat higher. DP Canyon near LA and Los Alamos Canyon near Los Alamos had several strontium-90 values above the drinking water MCL. The strontium-90 values are similar to prior runoff, surface water, and alluvial groundwater values in Los Alamos and DP Canyons.

In the four runoff samples collected at Cañada del Buey at White Rock, we detected all radiochemical parameters that we measure, except tritium, in at least one runoff sample. High suspended sediment levels in the samples are probably the source of the radioactivity. Samples collected in 1997 and 1998 showed similar levels of radioactivity, although in 1999 gross beta was lower than earlier samples, plutonium-238 was about five times higher, plutonium-239, -240 was lower, and uranium was about twice earlier values.

The Cañada del Buey at White Rock runoff samples had strontium-90 values ranging from five to seven times the drinking water MCL. These values are more than three times prior values and could reflect analytical laboratory problems.

Sources for the radioactivity seen at station Cañada del Buey at White Rock may include Area G at TA-54 or other Laboratory facilities along Cañada del Buey. Runoff samples from stations G-SWMS-4 and G-SWMS-6 on the east and north of Area G showed radioactivity comparable to the Cañada del Buey at White Rock runoff samples in 1998 and 1999.

Levels of radioactivity similar to those in the 1998 Cañada del Buey at White Rock runoff samples have not been seen in the past at the nearby sediment station. Another surface water station and two alluvial wells (CDBO-6 and CDBO-7) located upstream of Area G in Cañada del Buey have also not shown such high levels of radioactivity. However, the wells have had fairly large gross alpha and gross beta values; the gross alpha value at CDBO-6 also exceeded the DOE public dose DCG in 1998.

For runoff samples at TA-54, Area G, all radiochemical parameters measured except tritium were detected in at least one runoff sample. We have previously detected these radionuclides in sediment and runoff samples collected around Area G, and these results indicate that a small amount of radioactivity leaves the area because of surface erosion and runoff. The highest previous strontium-90 value for an Area G runoff station was 11.5 pCi/L in 1997; thirteen 1999 values exceed this level, and they range up to 101 pCi/L. These values could be a result of analytical laboratory problems.

Three stations in Ancho Canyon (North Fork Ancho Canyon at TA-39, Ancho Canyon at TA-39, and Ancho Canyon near Bandelier) showed several radiological constituents including cesium-137; americium-241; plutonium-239, -240; plutonium-238; gross beta and gamma; and uranium. The only recent sample from these stations was from Ancho Canyon near Bandelier in 1996; the sample had no significant radioactivity. Strontium-90 at these stations ranged from below to nine times (73.7 pCi/L) the EPA drinking water MCL. No recent runoff, surface water, or spring samples in Ancho Canyon have shown such high values of strontium-90, so the values could reflect analytical laboratory problems.

Pajarito Canyon above SR-4 had detections of cesium-137; americium-241; plutonium-239, -240; and plutonium-238. Pajarito Canyon above Threemile Canyon showed cesium-137 and plutonium-239, -240. These stations have not been sampled in the last few years; surface water samples have not shown such levels of radionuclides. One strontium-90 value at Pajarito Canyon above SR-4 exceeded the EPA drinking water MCL; such values have not been seen previously and may be the result of analytical laboratory problems.

Potrillo Canyon near White Rock showed the presence of cesium-137; americium-241; plutonium-239, -240; and gross gamma. Except for gross gamma, levels were similar to a 1997 sample. A strontium-90 value was about six times the 1997 level and may be the result of analytical laboratory problems.

Three stations in Sandia Canyon (Sandia Canyon below the Power Plant, Sandia Canyon below Wetlands, and Sandia Canyon near Roads & Grounds at TA-3) collectively showed the presence of americium-241; plutonium-238; plutonium-239, -240; and gross alpha, beta, and gamma. Prior runoff samples are not available for these stations, and the levels are higher than usually seen at surface water stations in Sandia Canyon. SCS-3 did have a lower, though unusual, detection of plutonium-238 in 1999. The three runoff stations had strontium-90 values at about half the EPA drinking water MCL. The values are higher than earlier surface water values in Sandia Canyon so may be the result of analytical laboratory problems.

c. Technical Area 50 Discharges. The cumulative discharge of radionuclides from the RLWTF into Mortandad Canyon between 1963 and 1977 and yearly discharge data for 1997 through 1999 appear in Table 5-5. In addition to total annual activity released for 1997 through 1999, Table 5-5 also shows mean annual activities in effluent for each radionuclide and the ratio of this activity to the DOE DCG for public dose. In 1999, americium-241, plutonium-238, and plutonium-239, -240 again exceeded the DCG. As mentioned above, the new reverse osmosis and ultrafiltration system began operation at the RLWTF in 1999. This system is designed to remove additional radionuclides from the effluent, and the discharges will meet the DOE public dose DCGs.

In response to a letter of noncompliance from the NMED, in March 1999 the RLWTF instituted a program to restrict the discharge of nitrogenous wastes into facility's collection system. As a result, the nitrate (nitrate as nitrogen) concentration of all effluent discharge from the RLWTF after March 21, 1999, was less than 10 mg/L. The average 1999 effluent nitrate concentration (value of 24.2 mg/L, nitrate as nitrogen) exceeded the New Mexico groundwater standard of 10 mg/L but was much lower than the values for the previous two years.

The fluoride concentration in the discharge also has declined over the last three years. The 1999 effluent fluoride concentration (average value of

1.12 mg/L) was below the New Mexico groundwater standard of 1.6 mg/L. The 1997 average effluent fluoride concentration exceeded the New Mexico groundwater standard by 25%, and in 1998 it was approximately equal to the standard.

4. Nonradiochemical Analytical Results

a. Major Chemical Constituents. Table 5-6 lists the results of analyses for major chemical constituents in surface water and runoff samples for 1999. The results are generally consistent with those observed in previous years, with some variability. The measurements in waters from areas receiving effluents show the effect of these effluents. None of the results were outside the ranges for standards with the following exception. The total dissolved solids (TDS) value at SCS-2 exceeded the EPA secondary drinking water standard. Several other TDS values (at SCS-1, SCS-3, Mortandad at Rio Grande, and Pueblo 3) exceeded half the EPA secondary drinking water standard, and sulfate at SCS-2 exceeded half the EPA secondary drinking water standard. The nitrate value for Mortandad at Rio Grande was about 51% of the NMWQCC Groundwater Standard. These stations are all downstream from sanitary sewage discharges.

b. Trace Metals. Table 5-7 lists the results of trace metal analyses on surface water and runoff samples for 1999. Samples collected for trace metal analysis (with the exception of unfiltered runoff samples) were filtered so that they could be compared to the NMWQCC standards that apply to dissolved constituents. Samples collected for mercury and selenium analysis were unfiltered, as the NMWQCC standards for these analytes apply to total metal content. The levels of trace metals in samples for 1999 are generally consistent with previous observations.

As in 1998, several surface water, runoff, and groundwater samples showed detections of selenium in 1999. Typically, selenium has not been detected in surface water or groundwater on the Pajarito Plateau. The analytical detection limit for selenium in 1999 samples was 3 µg/L, higher than in previous years and higher than the New Mexico Wildlife Habitat Standard of 2 µg/L. New Mexico changed this value to 5 µg/L in February 2000. Numerous selenium results reported as 3 µg/L do not appear to be detections (having three sigma uncertainties equal to the reported value), raising the question of whether these values indicate the presence of selenium. Selenium was present in runoff samples at Cañada del Buey near White Rock, three samples at Los Alamos Canyon near Los Alamos, Ancho Canyon at TA-39, North Fork Ancho Canyon at TA-39, Potrillo Canyon near White Rock, and G-SWMS-6.

The analytical detection limit for mercury (0.1 µg/L) is not adequate to determine whether it is present in excess of the New Mexico Wildlife Habitat stream standard of 0.012 µg/L. New Mexico changed this value to 0.77 µg/L in February 2000. In 1998, we did not detect mercury at any location with the exception of a runoff sample at Cañada del Buey at White Rock. For 1999, we detected mercury at Sandia Canyon Truck Route, Pajarito Canyon above Threemile Canyon, Los Alamos Canyon near Los Alamos, Los Alamos Canyon below TA-2, DP Canyon near Los Alamos, G-SWM-3, North Fork Ancho Canyon, Ancho Canyon near Bandelier, Ancho Canyon at TA-39, and Cañada del Buey at White Rock.

Runoff samples we collected at Los Alamos Canyon near Los Alamos again had lead levels exceeding NM Groundwater and Livestock Watering standards and showed the presence of beryllium, cadmium, and cobalt. Barium exceeded the New Mexico Groundwater limit. This station is upstream of State Road 4 in Los Alamos Canyon. Los Alamos Canyon below TA-2 also showed the presence of barium, beryllium, cobalt, and lead. DP Canyon near Los Alamos had beryllium, lead, and chromium.

Stations in Sandia Canyon had beryllium, lead, and chromium.

In addition to high levels of radioactivity as described earlier, runoff samples from Cañada del Buey at White Rock contained levels of barium, beryllium, cadmium, cobalt, nickel, and selenium near or exceeding regulatory standards. Note that some of these regulatory standards apply to groundwater or drinking water rather than expressly to surface water and are used for purposes of comparison.

Pajarito Canyon above Threemile Canyon had beryllium and cadmium. Pajarito Canyon above SR-4 showed beryllium and antimony. Potrillo Canyon near White Rock had barium, beryllium, cadmium, cobalt, and vanadium near or above regulatory limits. None of these stations have prior samples.

Stations in Ancho Canyon (North Fork Ancho Canyon at TA-39, Ancho Canyon at TA-39, and Ancho Canyon near Bandelier) had barium, beryllium, cadmium, cobalt, chromium, mercury, nickel, lead, selenium, and vanadium near or above regulatory standards. None of these stations have prior samples, except for Ancho Canyon near Bandelier on 6/29/96.

None of the metals that exceeded a standard in 1999 did so in the 1996 sample.

The Area G runoff stations showed the presence of barium, beryllium, cadmium, cobalt, chromium, mercury, nickel, lead, selenium, and vanadium near or above regulatory standards.

Aluminum, iron, and manganese concentrations exceed EPA secondary drinking water standards in surface water and runoff samples at many locations. These results reflect the presence of suspended solids in the water samples. Some of these cases occur with filtered samples. The results are due to naturally occurring constituents (e.g., aluminum, iron, and manganese) of minerals in the suspended solids.

c. Organic Constituents in Surface Water and Runoff. Table 5-8 summarizes the locations where we collected organic samples in 1999. (See Section 5.F.2.c. for analytical methods and analytes.) We analyzed samples for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and polychlorinated biphenyls (PCBs). Some samples were also analyzed for high-explosive (HE) constituents. No HE or other organic compounds were detected above the analytical laboratory's reporting level at any stations in 1999.

5. Long-Term Trends

Long-term trends for surface water are discussed in Section 5.D with groundwater trends.

C. Sediment Sampling

1. Introduction

Sediment transport associated with surface water runoff is a significant mechanism for contaminant movement. Contaminants originating from airborne deposition, effluent discharges, or unplanned releases can become attached to soils or sediments by adsorption or ion exchange.

There are no federal or state regulatory standards for soil or sediment contaminants that we can use for comparison with the Laboratory's environmental surveillance data. Instead, contaminant levels in sediments may be interpreted in terms of toxicity as a result of ingestion, inhalation, or direct exposure. The Laboratory's Environmental Restoration Project uses screening action levels (SALs) to identify contaminants at concentrations or activities of concern. SALs are screening levels selected to be less than levels that would constitute a human health risk. SAL values are derived from toxicity values and exposure parameters using data from the EPA.

We can also compare the data with activities of radionuclides resulting from atmospheric fallout or from naturally occurring radionuclides. We used radionuclide analyses of sediment samples collected from regional stations for the period 1974 to 1986 to establish background activities from atmospheric fallout of radionuclides and to determine the background concentrations of naturally occurring uranium (Purtymun et al., 1987). McLin et al. (in preparation) developed provisional background levels for data from the period 1974 to 1996. We use the average activity of each of the radionuclides in the regional station samples, plus twice its standard deviation, as an estimate of the upper limit of background values. This approach assumes that the regional station values are normally distributed and that about 95% of the regional station samples will fall within two standard deviations of the mean. If the activity of an individual sediment sample is greater than the estimated background value, we consider the Laboratory as a possible source of contamination. Tables summarizing analytical results list both background and SAL values for sediments.

2. Monitoring Network

Sediments are sampled in all major canyons that cross the Laboratory, including those with either perennial or ephemeral flows. We also sample sediments from regional reservoirs and stream channels annually.

Regional sediment sampling stations (Figure 5-1) are located within northern New Mexico and southern Colorado at distances up to 200 km from the Laboratory. Samples from regional stations provide a basis for estimating background activities of radionuclides resulting from atmospheric fallout or from naturally occurring radionuclides. We obtained regional sediment samples from reservoirs on the Rio Grande and the Rio Chama and at stations on the Rio Grande and Jemez River.

Stations on the Pajarito Plateau (Figure 5-5) are located within about 4 km of the Laboratory boundary, with the majority located within the Laboratory boundary. The information gathered from these stations documents conditions in areas potentially affected by Laboratory operations. Many of the sediment sampling stations on the Pajarito Plateau are located within canyons to monitor sediment contamination related to past and/or present effluent release sites. We sampled three major canyons (Pueblo, Los Alamos, and Mortandad Canyons) that have experienced past or present liquid radioactive releases from upstream of the Laboratory to their confluence with the Rio Grande.

We also collected sediments from drainages downstream of two material disposal areas. Area G at TA-54 is an active waste storage and disposal area. Nine sampling stations were established outside its perimeter fence in 1982 (Figure 5-4) to monitor possible transport of radionuclides from the area. The surface drainage changed, and we dropped two sampling stations in 1998 and added four others. G-4 R-1 and G-4 R-2 replaced station G-4. G-6 was located in a channel that received runoff that was not entirely from Area G. G-6R replaced G-6 and is located in a stream channel that receives runoff only from Area G. Station G-0 was added on the north side of Area G in a drainage that flows to Cañada del Buey. We collected special samples in 1999 at the Transuranic Waste Inspectable Storage Project (TWISP) Dome at Silt Fence and G3-01 and G3-02.

Area AB at TA-49 was the site of underground nuclear weapons testing from 1959 to 1961 (Purtymun and Stoker 1987, ESP 1988). The tests involved high explosives and fissionable material insufficient to produce a nuclear reaction. We established 11 stations in 1972 to monitor surface sediments in drainages adjacent to Area AB (Figure 5-6). We added another station (AB-4A) in 1981 as the surface drainage changed.

Two special sediment sampling events occurred in 1999. In response to high values of gross alpha and gross beta in runoff samples collected at Cañada del Buey at White Rock, we collected sediment samples at five sites along Cañada del Buey in White Rock (Figure 5-7). At each location, we collected several samples from different depths. Table 5-9 provides the information on sediment sample depths. In December, the EPA conducted special sampling of sediments in Ancho, Bayo, Cañada del Buey, Mortandad, Pajarito, and Sandia Canyons. LANL collected split samples at these locations; most of the samples came from outside of the Laboratory boundary (Figure 5-8). See Table 5-9 for information on sediment sample depths.

3. Radiochemical Analytical Results for Sediments

Table 5-10 shows the results of radiochemical analysis of sediment samples collected in 1999. The sample size for most sediment samples is 100 g. Reservoir sample sizes for plutonium-238 and plutonium-239, -240 are 1,000 g, resulting in limits of detection of 0.0001 pCi/g. As discussed in Section 5.F, the analytical laboratory had data quality problems with analysis of strontium-90 for 1999. Therefore, the strontium-90 data appear in a separate table, Table 5-11. To emphasize values that are detections, Tables 5-12 and 5-13 list radiochemical detections for values that are higher than background levels and also identify values that are near or above SALs. Tritium has no established background value for sediments, so Table 5-12 shows all tritium detections. Detections are defined as values exceeding both the analytical method detection limit and three times the individual measurement uncertainty. The analytical laboratory determined analysis-specific detection limits for many radiochemical measurements in 1999, which are listed in Tables 5-3 and 5-4. Individual detection limits were not provided for gross alpha, gross beta, or uranium. Because of analytical laboratory delays, many sediment stations did not have results completed for plutonium-238, plutonium-239, -240, and americium-241 in time for this report; these data will appear in the next report. Except for strontium-90, results from the 1999 sediment sample analysis are generally consistent with historical data.

Strontium-90 was above fallout levels in all 105 sediment samples where it was detected in samples from the Pajarito Plateau and at regional stations in 1999. These high values resulted from problems with a new strontium-90 laboratory technique. Strontium-90 has previously been detected infrequently at most stations.

For 1999, samples from the upper and lower stations in Rio Grande Reservoir (Colorado) had cesium-137 at activities from 20 to 50% above background. In 1998, sediment samples from all three stations in the reservoir contained cesium-137 at activities up to 70% above background. Cesium-137 activity in sediments analyzed from that reservoir in 1996 and 1997 was 20 to 30% greater than background. We detected tritium in two samples at Abiquiu Reservoir at levels from 15 to 30% of the EPA drinking water MCL. Guaje Reservoir sediments contained above background values of gross alpha, gross beta, cesium-137, and uranium. These values were a few percent above background except for uranium, which was about 250% of background. The levels of tritium, strontium-90, plutonium-238, plutonium-239, -240, americium-241, gross beta, and gross gamma in all other reservoirs were below background values.

A sediment sample collected from station Rio Grande at Bernalillo yielded a plutonium-238 value nearly 70% above background. The sample from the Jemez River had a plutonium-238 value slightly above background.

Many 1999 sediment samples from the known radioactive effluent release areas in Acid/Pueblo, DP/Los Alamos, and Mortandad Canyons exceeded background levels for tritium, cesium-137, plutonium-238, plutonium-239, -240, americium-241, gross alpha, gross beta, and gross gamma activities. These levels are consistent with historical data.

Within both Los Alamos and Pueblo Canyon sediments, above-background levels of plutonium are evident for distances greater than 16 km downstream from the sources in Acid and DP Canyons. The contamination extends off-site across San Ildefonso Pueblo lands and reaches the Rio Grande near the Otowi Bridge. Plutonium-238 and plutonium-239, -240 activities downstream of historical release sites in those canyons have remained relatively constant during the past. These patterns have been documented for several decades in Laboratory reports (ESP 1981).

At station DPS-4 in DP Canyon, activities of cesium-137, plutonium-238, and plutonium-239, -240 were about four times background in 1999, consistent with historical data.

At Acid Weir (at the confluence of Acid Canyon and Pueblo Canyon), plutonium-238 was five times background, and plutonium-239, -240 activity was nearly 300 times background (and about one-fourth of the SAL). Americium-241 was five times background. These values are all consistent with historical data.

Plutonium-239, -240 was 42 times background at Pueblo 2, 8 times background at Pueblo 3, and was 47 times greater than background at Pueblo State Road 502. The activities of radionuclides at other sediment stations in Acid/Pueblo Canyons and DP/Los Alamos Canyons in 1999 were near background.

Within Mortandad Canyon, the greatest radionuclide levels in sediments are found between the point where the TA-50 RLWTF effluent enters the drainage (station GS-1) and the sediment traps (MCO-7), approximately a 3-km distance. Radionuclide levels decrease in the downstream direction from TA-50 to the sediment traps. Radionuclide levels near, or slightly exceeding, background levels are found downstream of the sediment traps, extending to the Laboratory/San Ildefonso Pueblo boundary station A-6. Based on mass spectrometry analysis, Gallaher concluded that off-site plutonium contamination at levels near fallout values might extend two miles beyond the Laboratory boundary (Gallaher et al., 1997).

In 1999, sediment samples from GS-1, MCO-5, and MCO-7 in Mortandad Canyon showed cesium-137 concentrations that were up to five times greater than the SAL value. Median values since 1980 for cesium-137 at these stations range up to six times greater than the SAL value. Cesium-137 levels at these stations have declined by factors of five to 35 since the early 1980s because of lower cesium-137 discharges from the RLWTF. The plutonium-239, -240 activity at MCO-5 was over three times the SAL, and plutonium-238 activity was just over the SAL. The validity of these plutonium values is uncertain: duplicate plutonium analyses for this sample from MCO-5 gave results for both plutonium-238 and plutonium-239, -240 that were exactly one-tenth of these unusually high values, and the gross alpha values for the samples do not support the higher plutonium results. During 1999, no other sediment samples in Mortandad Canyon showed any values that exceeded SAL values.

Downstream of the sediment traps at stations MCO-9 and MCO-13 in Mortandad Canyon, plutonium-238 and cesium-137 activities and uranium concentrations were below background values. This result is consistent with data from the last 15 years.

A number of sediment samples in the vicinity and downstream of Area G contained plutonium-238 at activities greater than background. Plutonium-238 was 60 times background at G-9 and more than 20 times background at G-7. G-7, G-9, and G-6R had plutonium-239, -240 activities more than 10 times background. Tritium was also found at G-4 R-1, G-4 R-2, G-7, and TWISP Dome at Silt Fence. The station Pajarito at State Road 4, which is located more than one km downstream of Area G, had cesium-137 and plutonium-239, -240 at levels greater than background and plutonium-238 at nearly 70 times background.

We found plutonium-238 and plutonium-239, -240 at activities greater than background in a number of sediment samples collected at Area AB. Station AB-3 is located immediately downstream of a known surface-contamination area dating to 1960 (Purtymun and Stoker, 1987). At AB-3, plutonium-239, -240 was again nearly 50 times background, and plutonium-238 was three times background activity. These values are consistent with past results.

At Ancho at SR-4, tritium was detected. Chaquehui at Rio Grande and Fence at SR-4 both had detections of cesium-137 and plutonium-239, -240 slightly above background.

We collected sediment samples in White Rock at five sites along Cañada del Buey (Figure 5-7). At site #5 in Overlook Park, we found plutonium-239, -240 at over 30 times background levels. At site #2 on Rover near the stream channel, plutonium-239, -240 was found at twice background.

In December, the EPA conducted special sampling of sediments in Ancho, Bayo, Cañada del Buey, Mortandad, Pajarito, and Sandia Canyons. LANL collected split samples at each station. Sandia Canyon 3 showed a detection of tritium. Bayo Canyon 1 and Sandia Canyon 5 had cesium-137 slightly above background.

The remainder of sediment samples collected at locations at the Laboratory in 1999 were near background levels.

4. Nonradiochemical Analytical Results

a. Trace Metals. Beginning in 1992, we have analyzed sediments for trace metals. Table 5-14 presents trace metal results for the sediment samples collected in 1999.

Several trace metal values for sediments appear to be up to about 1,000 times larger than prior values for the station or values found at nearby stations. The large values could be due to analytical laboratory errors, but no errors were found upon reexamining data packages. At Cochiti Lower, a selenium value of 440 mg/kg contrasts with nondetects at nearby stations and prior measurements of either nondetection or of 0.6 mg/kg. Acid Weir had a lead value of 150 mg/kg, compared with five prior measurements ranging from 15 to 32 mg/kg. The manganese value at Pueblo at SR-4 was reported as 18,563 mg/kg, while six prior values ranged from 200 to 650 mg/kg.

Since 1990, trace metals analysis has indicated the presence of mercury at near detection limit concentrations (0.025 mg/kg) in nearly 200 sediment samples. The largest numbers of those historic samples (from 1990–1998) were from Los Alamos Canyon (22 samples), followed by Mortandad Canyon (21 samples since 1992), Area AB (19 samples), and Area G (15 samples since 1994). In 1999, we did not find mercury in sediments in Los Alamos Canyon, Area G, or Area AB. Mortandad Canyon stations Mortandad West of GS-1, Mortandad at GS-1, and Mortandad at MCO-5 had low levels of mercury, far below the SAL of 23 mg/kg. During the special EPA sampling, mercury was detected in Ancho, Bayo, Cañada del Buey, Mortandad, Pajarito, and Sandia Canyons. The highest value, at Ancho Canyon 1, was 1% of the SAL.

The SAL for arsenic is 19 mg/kg. Several stations show arsenic in sediments at levels larger than about half the SAL, including Heron (7 to 14 mg/kg) and Abiquiu Reservoirs (4 to 11 mg/kg), Pueblo at SR-502 (7.5 mg/kg), and Pajarito at SR-4 (9 mg/kg). Previously, seven arsenic results for Heron Reservoir stations show a mean and maximum of 10.8 and 34 mg/kg; seven samples for Abiquiu Reservoir show a mean and maximum of 4.1 and 8 mg/kg. The three earlier arsenic results for Pueblo at SR-502 have a mean and maximum of 1.4 and 3 mg/kg; seven samples for Pajarito at SR-4 show a mean and maximum of 0.7 and 1.1 mg/kg.

Chromium was found above or near the hexavalent chromium SAL of 30 mg/kg (the total chromium SAL is 210 mg/kg) at Heron, Abiquiu, Cochiti, and Guaje Reservoirs and also during the special EPA sampling in Pajarito and Sandia Canyons. Previously seven chromium results for Heron Reservoir stations show a mean and maximum of 14.6 and 18.1 mg/kg; seven samples for Abiquiu Reservoir show a mean and maximum of 10.7 and 22 mg/kg. Seven earlier chromium results for Cochiti Reservoir stations show a mean and maximum of 14.7 and 22 mg/kg. The three earlier chromium results for Pueblo at SR-502 have a mean and maximum of 7 and 14 mg/kg; seven samples for Pajarito at SR-4 show a mean and maximum of 6.2 and 13 mg/kg.

b. Organic Analysis. Beginning in 1993, we have analyzed sediments for PCB and SVOCs. Some sediment samples have been analyzed for HE constituents since 1995. We analyze samples from only a portion of the sediment stations each year. Table 5-15 lists these samples. The analytical results showed no PCB, SVOCs, or HE constituents detected above the analytical laboratory's reporting limit in any of the sediment samples collected during 1999.

5. Long-Term Trends

For the plots discussed in this section, we show only detections of a particular radionuclide in sediments; samples without such detections are not shown.

Figure 5-9a depicts plutonium-238 activities at five stations in Mortandad Canyon from 1976 to 1999. GS-1, MCO-5, and MCO-7 are located downstream of the

RLWTF discharge point and upstream of the sediment traps. Plutonium-238 activity at GS-1 has decreased by a factor of about 10 during that time period and, except for a 1999 sample at MCO-5, has not exceeded the SAL since 1985. MCO-9 and MCO-13 are located downstream of the sediment traps. Plutonium-238 is infrequently above background at those stations and is not regularly detected.

Figure 5-9b shows plutonium-239, -240 levels on Laboratory lands in Mortandad Canyon. Plutonium-239, -240 levels upstream of the sediment traps have declined by approximately a factor of ten since the 1980s, presumably because of decreased radioactivity in the RLWTF discharges and the dispersion of previously contaminated sediments. Downstream of the sediment traps, plutonium activities have remained relatively constant; the activities are two orders of magnitude less than upstream of the sediment traps and are near background activities.

Figure 5-9c shows that cesium-137 has been present in Mortandad Canyon since the 1970s. Between TA-50 and the sediment traps, cesium-137 levels have often exceeded the SAL but have decreased over the last 25 years. Cesium-137 levels below the sediment traps have gradually declined to near background levels.

D. Groundwater Sampling

1. Introduction

Groundwater resource management and protection efforts at the Laboratory are focused on the regional aquifer underlying the region (see Section 1.A.3) but also consider groundwater found within canyon alluvium and perched at intermediate depths above the regional aquifer. The Los Alamos public water supply comes from supply wells drawing water from the regional aquifer.

The early groundwater management efforts by the USGS evolved through the growth of the Laboratory's current Groundwater Protection Management Program, required by DOE Order 5400.1 (DOE 1988). This program addresses environmental monitoring, resource management, aquifer protection, and hydrogeologic investigations. The Laboratory issued formal documentation for the program, the "Groundwater Protection Management Program Plan," in April 1990 and revised it in 1995 (LANL 1996a). During 1996, the Laboratory developed and submitted an extended groundwater characterization plan, known as the Hydrogeologic Workplan (LANL 1996b), to the NMED. NMED approved the Hydrogeologic Workplan on March 25, 1998. Investigations under the Hydrogeologic Workplan are described in Chapter 2.

Concentrations of radionuclides in environmental water samples from the regional aquifer, the alluvial groundwater in the canyons, and the intermediate-depth perched systems may be evaluated by comparison with DCGs for ingested water calculated from DOE's public dose limit (see Appendix A for a discussion of standards). The NMWQCC has also established standards for groundwater quality (NMWQCC 1993). Concentrations of radioactivity in drinking water samples from the water supply wells, which draw water from the regional aquifer, are compared with New Mexico Environmental Improvement Board (NMEIB) and EPA MCLs or to the DOE DCGs applicable to radioactivity in DOE drinking water systems, which are more restrictive in a few cases.

The concentrations of nonradioactive chemical quality parameters may be evaluated by comparing them with NMWQCC groundwater standards and with the NMEIB and EPA drinking water standards, although these latter standards are only directly applicable to the public water supply. Although it is not a source of municipal or industrial water, shallow alluvial groundwater is a source of return flow to surface water and springs used by livestock and wildlife and may be compared with the Standards for Groundwater or the Livestock Watering and Wildlife Habitat Stream Standards established by the NMWQCC (NMWQCC 1993, NMWQCC 1995). However, it should be noted that these standards are for the most part based on dissolved concentrations. Many of the results reported here are total concentrations (that is, they include both dissolved and suspended solids concentrations), which may be higher than dissolved concentrations alone.

2. Monitoring Network

Groundwater sampling locations are divided into three principal groups, related to the three modes of groundwater occurrence: the regional aquifer, alluvial groundwater in the canyons, and localized intermediate-depth perched groundwater systems. Figure 5-10 shows the sampling locations for the regional aquifer and the intermediate-depth perched groundwater systems. Figure 5-11 presents the sampling locations for the canyon alluvial groundwater systems. Purtymun (1995) described the springs and wells.

Sampling locations for the regional aquifer include test wells, supply wells, and springs. New wells constructed by the Hydrogeologic Workplan activities are not yet part of the monitoring network.

We routinely sample eight deep test wells, completed within the regional aquifer. The USGS drilled these test wells between 1949 and 1960 using the cable tool method. The Laboratory located these test wells where they might detect infiltration of contaminants from areas of effluent disposal operations. These wells penetrate only a few tens or hundreds of feet into the upper part of the regional aquifer. The casings are not cemented because that would seal off surface infiltration along the boreholes.

We collect samples from 13 deep-water supply wells in three well fields that produce water for the Laboratory and community. The well fields include the off-site Guaje well field and the on-site Pajarito and Otowi well fields. The Guaje well field, located northeast of the Laboratory, now contains five wells. With one exception (G-1A), the older wells were retired in 1999 because of their age. Four new wells were drilled in this field in 1998. Three of the former wells and three of the remaining wells had significant production during 1999. The five wells of the Pajarito well field are located in Sandia and Pajarito Canyons and on mesa tops between those canyons. Two wells make up the Otowi well field, located in Los Alamos and Pueblo Canyons. We took additional regional aquifer samples from wells located on San Ildefonso Pueblo.

We sample numerous springs near the Rio Grande because they represent natural discharge from the regional aquifer (Purtymun et al., 1980). As such, the springs serve to detect possible discharge of contaminated groundwater from beneath the Laboratory into the Rio Grande. Based on their chemistry, the springs in White Rock Canyon are divided into four groups, three of which have similar, regional aquifer-related chemical quality. The chemical quality of springs in a fourth group reflects local conditions in the aquifer, probably related to discharge through faults or from volcanics. Sacred Spring is west of the river in lower Los Alamos Canyon.

We sample approximately half of the White Rock Canyon springs each year. Larger springs and springs on San Ildefonso Pueblo lands are sampled annually, with the remainder scheduled for alternate years.

We sample the alluvial groundwater in five canyons (Pueblo, Los Alamos, Mortandad, and Pajarito Canyons, and Cañada del Buey) with shallow observation wells to determine the impact of NPDES discharges and past industrial discharges on water quality. In any given year, some of these alluvial observation wells may be dry, and thus we cannot obtain water samples. Observation wells in Water, Fence, and Sandia Canyons have been mostly dry since their installation in 1989. All but two of the wells in Cañada del Buey are generally dry.

Intermediate-depth perched groundwater of limited extent occurs in conglomerates and basalt at depths of several hundred feet beneath the alluvium in portions of Pueblo, Los Alamos, and Sandia Canyons. We obtain samples from two test wells and one spring. The well and spring locations allow us to monitor possible infiltration of effluents beneath Pueblo and Los Alamos Canyons.

Some perched water occurs in volcanics on the flanks of the Jemez Mountains to the west of the Laboratory. This water discharges at several springs (Armstead and American) and yields a significant flow from a gallery in Water Canyon, where this perched water is sampled. During the winter of 1996–97, a falling tree broke the connecting pipe, and the water now flows down Water Canyon. We now sample the gallery at the point where the pipe broke. Additional perched water extends eastward from the Jemez Mountains beneath TA-16 in the southwestern portion of the Laboratory. The drilling of Hydrogeologic Workplan well R-25 confirmed the existence of this perched water, at a depth of about 750 ft below the mesa top in 1998. The water was found to contain high-explosives compounds resulting from past Laboratory discharges. We are conducting further work to characterize this perched zone.

3. Radiochemical Analytical Results for Groundwater

Table 5-16 lists the results of radiochemical analyses of groundwater samples for 1999. As discussed in Section 5.F, the analytical laboratory had data quality problems with analysis of strontium-90 for 1999. Therefore, the strontium-90 data are presented in a separate table, Table 5-17. LANL strontium-90 values fall into two groups—regular and low-level analyses. Where NMED split sample data are available, we have presented them for comparison.

To emphasize values that are detections, Tables 5-18 and 5-19 list radionuclides detected in groundwater samples. Detections are defined as values exceeding both the analytical method detection limit and three times the individual measurement uncertainty. The analytical laboratory determined analysis-specific detection limits for many radiochemical measurements in 1999, which appear in Tables 5-18 and 5-19. They did not provide individual detection limits for gross alpha, gross beta, or uranium. Because uranium, gross alpha, and gross beta are almost always detected, we indicate in Table 5-18 only occurrences of these measurements above threshold values. The specific levels are 5 µg/L for uranium, 5 pCi/L for gross alpha, and 20 pCi/L for gross beta and are lower than the EPA MCLs or screening levels.

The righthand columns of Tables 5-18 and 5-19 indicate radiochemical detections that are greater than 1/25 of the DOE DCGs for public dose for ingestion of environmental water (1/25 of the DOE DCG for public dose is the DOE drinking water system DCG). The EPA drinking water limits for gross alpha and gross beta values are higher than 1/25 of the DOE public dose DCG (that is, greater than the DOE drinking water system DCGs), so we use the EPA values to screen gross alpha and gross beta values. The DCG value for gross beta is actually the strontium-90 DCG, and the DCG for gross alpha is the plutonium-239, -240 DCG. These DCGs were chosen because the isotopes represented had the lowest DCGs for alpha and beta emitters. No groundwater values exceeded half the DOE public dose DCG values in 1999.

Discussion of results will address the regional aquifer, the canyon alluvial groundwater, and the intermediate-depth perched groundwater system.

a. Radiochemical Constituents in the Regional Aquifer. For samples from wells or springs in the regional aquifer, most of the results for radiochemical measurements were below the DOE drinking water DCGs or the EPA or New Mexico standards applicable to a drinking water system. In addition, most of the results were near or below the detection limits of the analytical methods used. The exceptions are discussed below.

The main detected radioactive element was uranium, found in springs and wells on San Ildefonso Pueblo land. See Section 5.E for a discussion of these values.

Supply wells G-6 and PM-1, Test Wells 3 and 4, and Spring 6A showed apparent detections of americium-241 at low levels. Numerous other surface water, runoff, and groundwater samples had detections of americium-241 at low levels, as did two DI blanks.

Analytical laboratory problems caused many apparent detections of strontium-90 where it has not been seen previously. Levels of strontium-90 exceeding the drinking water MCL of 8 pCi/L were apparently detected in Test Wells 1, 3, 4, 8, DT-9, DT-10, and Sanchez House Well at San Ildefonso Pueblo. Strontium-90 was also detected in Los Alamos water supply wells G-1, G-1A, O-1, O-4, and PM-4 and San Ildefonso Pueblo water supply wells LA-5, Don Juan Playhouse Well, Pajarito Well (Pump 1), and Eastside Artesian Well. Sacred Spring and Spring 8B showed strontium-90 detections. LANL believes that none of these detections are valid and that they are due to analytical laboratory problems. The NMED split samples collected at many of the wells, which show no detection of strontium-90, support this conclusion. The NMED data did show a strontium-90 detection at PM-1.

b. Radiochemical Constituents in Alluvial Groundwater. None of the radionuclide activities in alluvial groundwater are above the DOE DCGs for public dose for ingestion of environmental water. Except for gross beta, americium-241, and strontium-90 values from Mortandad and Los Alamos Canyons, none of the radiochemical measurements exceed DOE DCGs applicable to a drinking water system. Levels of tritium; cesium-137; uranium; plutonium-238; plutonium-239, -240; and gross alpha, beta, and gamma are all within the range of values observed in recent years.

In Pueblo Canyon, samples from APCO-1 showed detections of americium-241 and plutonium-239, -240. This well had plutonium-239, -240 above the detection limit in most years since 1994. We have seen similar values in previous years in surface water and alluvial groundwater in Pueblo Canyon, as a consequence of past Laboratory discharges.

The samples of alluvial groundwater in Los Alamos and DP Canyons show residual contamination, as we have seen since the original installation of monitoring wells in the 1960s. In particular, for LAO-1, LAO-2, and LAO-3A, the activity of strontium-90 usually approaches or exceeds the EPA primary drinking water MCL of 8 pCi/L. Strontium-90 was apparently detected in every alluvial well in Los Alamos and DP Canyons in 1999; most values are suspect because of analytical laboratory problems. Plutonium-239, -240 was not detected in LAO-0.7 for the first year since 1993. A number of wells had detections of low values of americium-241, which may be the result of analytical laboratory problems; numerous other wells, springs, surface water samples, and two blanks had detections in the same range. Several wells showed gross beta activities approaching or exceeding the drinking water screening level of 50 pCi/L.

The alluvial groundwater samples from Mortandad Canyon showed activities of radionuclides within the ranges observed previously. Tritium; strontium-90; cesium-137; plutonium-238; plutonium-239, -240; americium-241; and gross alpha, beta, and gamma are usually detected in many of the wells. The radionuclide levels are in general highest nearest to the TA-50 RLWTF outfall at well MCO-3 and decrease down the canyon. The levels of tritium, strontium-90, and gross beta usually exceed EPA drinking water criteria in many of the wells. In some years, the levels (except for tritium) exceed the DOE drinking water system DCGs, but the levels do not exceed the DOE DCGs for public dose for ingestion of environmental water. EPA has no drinking water criteria for plutonium-238; plutonium-239, -240; or americium-241. Except for americium-241 in MCO-3, the DOE Drinking Water System DCGs for these latter radionuclides were not exceeded in Mortandad Canyon alluvial groundwater in 1999 samples.

PCO-1 had unusual detections of plutonium-238 and americium-241 in a sample taken March 26. A second sample on December 9 did not detect plutonium-238; americium-241 was not analyzed in the second sample. In 16 samples taken since 1985, we have never detected plutonium-238 at this well. Americium-241 was detected only once, in 1995, out of five previous samples analyzed.

Two wells in Cañada del Buey contain little water and in the past often yielded very turbid samples. Except for strontium-90, we detected no radiochemical parameters in these wells in 1999. In 1998, Cañada del Buey well CDBO-6 had detections of gross alpha and gross beta. The 1999 strontium-90 detection is likely the result of analytical laboratory problems.

c. Radiochemical Constituents in Intermediate-Depth Perched Groundwater. In the 1950s, based on measurements of water levels and major inorganic ions, the USGS established that contaminated surface water and alluvial groundwater in Pueblo Canyon recharge the intermediate-depth perched zone water that underlies the canyon floor (Weir et al., 1963; Abrahams 1966). Taken over time, the radionuclide activity measurements in samples from TW-1A, TW-2A, and Basalt Spring in Pueblo and Los Alamos Canyons confirm this connection. TW-2A, furthest upstream and closest to the historical discharge area in Acid Canyon, has shown the highest levels. We detected no tritium in TW-2A in 1999; 1997 and 1999 are the only years since 1991 with no tritium detections. Tritium levels in that well averaged at about 2,590 pCi/L from 1992 through 1996. We found no detectable plutonium-239, -240 in Basalt Spring, TW-1A, or TW-2A, in contrast to earlier years. Strontium-90 was detected in Test Well 2A at a very high value and in Basalt Spring. These detections are likely the result of analytical laboratory problems. The sample from the Water Canyon Gallery, which lies southwest of the Laboratory, was consistent with previous results, showing no evidence of radionuclides from Los Alamos operations.

4. Nonradiochemical Analytical Results

Table 5-20 lists the results of general chemical analyses of groundwater samples for 1999, and results of trace metal analyses appear in Table 5-21.

a. Nonradiochemical Constituents in the Regional Aquifer. With the exceptions discussed here, values for all parameters measured for environmental surveillance sampling in the water supply wells are within drinking water limits. Separate samples were collected from the public water supply system to determine regulatory compliance with the Safe Drinking Water Act, and these samples were all in compliance for 1999 (see Section 2.9).

For well G-2, the fluoride level was over half the standard of 1.6 mg/L and was similar to previous measurements. The vanadium values in new wells G-2A, G-3A, and G-5A were about 60% of the EPA health advisory range of 80 to 110 µg/L. This result, along with detection of cobalt in G-5A, may be due to new well construction.

The test wells in the regional aquifer showed levels of several constituents that approach or exceed standards for drinking water distribution systems. However, it should be noted that the test wells are for monitoring purposes only and are not part of the water supply system. TW-1 had a nitrate value of 5.8 mg/L (nitrate as nitrogen), again below the EPA primary drinking water standard of 10 mg/L. This test well has shown nitrate levels in the range of about 5 to 20 mg/L (nitrate as nitrogen) since the early 1980s. The source of the nitrate might be infiltration from sewage treatment effluent released into Pueblo Canyon or residual nitrates from the now decommissioned TA-45 radioactive liquid waste treatment plant that discharged effluents into upper Pueblo Canyon until 1964. Nitrogen isotope analyses the ER Project made during 1998 indicate that the nitrate is from a sewage source (Nylander et al., 1999).

Six groundwater samples and several surface water samples showed an apparent detection of selenium in 1998. Typically, we have not detected selenium in groundwater on the Pajarito Plateau. Selenium was found in Los Alamos Canyon alluvial groundwater and in each of the three DT series test wells at TA-49. We detected no selenium at these sites in 1999, suggesting that the previous year's values, which were close to the detection limit, did not indicate its presence. In 1999, we detected selenium at low levels at Spring 1 and Spring 9.

Test Well 1 had a lead concentration above the EPA action level and a high antimony concentration, similar to past values attributed to metal flaking from hardware in the well. Levels of trace metals that approach water quality standards in some of the test wells are believed to be associated with turbidity of samples and with the more than 40-year-old steel casings and pump columns. In the last few years, iron, manganese, cadmium, nickel, antimony, and zinc have been high in several of the regional aquifer test wells. The lead levels appear to result from flaking of piping installed in the test wells and do not represent lead in solution in the water (ESP 1996a).

La Mesita Spring had a nitrate value of 5.4 mg/L (nitrate as nitrogen), at the upper limit of past values. Samples collected for metals analysis from most of the White Rock Canyon springs were filtered in 1999. Many of the springs have very low flow rates, and we collected samples in small pools in contact with the surrounding soils. Except for selenium, none of the springs showed trace metals at levels of concern in 1999.

b. Nonradiochemical Constituents in Alluvial Groundwater. The canyon bottom alluvial groundwater in Pueblo, Los Alamos, and Mortandad Canyons receives effluents. The groundwater shows the effects of those effluents in that values of some constituents are elevated above natural levels.

The Mortandad Canyon groundwater samples in Table 5-20 exceeded or approached the NMWQCC Groundwater Standards for fluoride and nitrate. The nitrate source is nitric acid from plutonium processing at TA-55 that enters the TA-50 waste stream. In response to a letter of noncompliance from the NMED, in March 1999 the RLWTF instituted a program to restrict the discharge of nitrogenous wastes into the facility's collection system. As shown in Figure 5-12, the nitrate (nitrate as nitrogen) concentration of effluent discharge from the RLWTF after March 21, 1999, was less than 10 mg/L.

Under the Laboratory's groundwater discharge plan application for the RLWTF, we collected separate samples for nitrate, fluoride, and TDS bimonthly from four alluvial monitoring wells in Mortandad Canyon during 1999: MCO-3, MCO-4B, MCO-6, and MCO-7. We reported the analytical results quarterly to the NMED. During 1999, nitrate concentrations in alluvial groundwater wells MCO-3, MCO-4B, and MCO-6 displayed a downward trend, as Figure 5-12 shows. By December 1999, nitrate concentrations at these three wells were below the NMWQCC Groundwater Standard for nitrate of 10 mg/L (nitrate as nitrogen). Beginning in June 1999, fluoride concentrations in discharged effluent and at all four wells were below the NMWQCC Groundwater Standard for fluoride of 1.6 mg/L, as shown in Figure 5-12.

The pH in PCO-1 was again below the EPA secondary drinking water range of 6.8–8.5. The pH of CDBO-6 was reported as 1.7, with a conductance reported as 11,600 µS/cm. Neither of these values is realistic; both probably represent analytical laboratory aberrations. Usual values are pH of 7.3 and conductance of 200 µS/cm.

In 1998, we detected beryllium and barium in Cañada del Buey wells CDBO-6 and CDBO-7. We also found lead at high levels in these wells in 1998. We found none of these constituents in 1999, possibly because the samples were much less turbid as a result of lower pumping rates during sampling.

LAO-3A continued to show levels of molybdenum just below the New Mexico Groundwater Limit. LAO-5 had a detection of beryllium below the EPA drinking water MCL, and MT-3 had a value just above the MCL.

c. Nonradiochemical Constituents in Intermediate-Depth Perched Groundwater. In 1999, the nitrate values for TW-2A and Basalt Spring were well below NMWQCC Groundwater and EPA Drinking Water Standards. These sample locations have occasionally shown higher nitrate values in recent years. The source of the nitrate is infiltration of contaminated surface water and shallow groundwater from Pueblo Canyon.

TW-2A again had levels of iron, lead, manganese, and zinc approaching or exceeding water quality standards. The detection of metals in these test wells probably reflects either suspended sediments or the flaking of metals from pump hardware and the well casing rather than the existence of dissolved metals in the groundwater. Otherwise, the intermediate-depth perched groundwater samples from these stations and the Water Canyon gallery did not show any concentrations of nonradiochemical constituents that are of concern.

d. Organic Constituents in Groundwater. We performed analyses for organic constituents on selected springs and test wells in 1999. The stations sampled appear in Table 5-22. Some samples were analyzed for VOCs, SVOCs, and PCBs. Water supply wells, test wells, and most springs were analyzed for HE constituents. No organic or high-explosive constituents were found above the analytical laboratory's reporting limit in the groundwater samples listed in Table 5-22. We rejected most of the possible organic detections reported by the analytical laboratory because the compounds were either detected in method blanks (that is, they were introduced during laboratory analysis) or detected in trip blanks. Trip blanks go along during sampling to determine if organic constituents come from sample transportation and shipment.

e. Special Water Supply Sampling. In 1998, drilling of characterization well R-25 at TA-16 in the southwest portion of the Laboratory revealed the presence of high-explosive constituents at concentrations above the EPA Health Advisory guidance values for drinking water. As a result, the Laboratory tested all nearby water supply wells for these compounds. None of the analytical laboratories detected any high explosives or their degradation products in any of the water samples from any of the supply wells sampled. In 1999, because of continuing concerns over possible contamination of the regional aquifer, LANL implemented quarterly sampling of some water supply wells for selected constituents. Table 5-23 lists the dates and constituents sampled. PM-2, 4, and 5 are closest to R-25 where HE was found in groundwater in 1998. We did not find HE in any of the water supply well samples in 1999. Samples from PM-1 and O-4 showed strontium-90 and PM-2 and PM-5 showed no perchlorate during 1999. The Analytical Chemistry Sciences Group (CST-9) analyzed these strontium-90 samples.

5. Long-Term Trends

a. Regional Aquifer. The long-term trends of the water quality in the regional aquifer have shown limited impact resulting from Laboratory operations. In 1998, drilling characterization well R-25 at TA-16 in the southwest portion of the Laboratory revealed the presence of high-explosive constituents. No high-explosive constituents have been found in water supply wells. The extent of high explosives in the regional aquifer is presently unknown. The Laboratory is working in cooperation with regulatory agencies to define the extent of the contamination and ensure that drinking water supplies are adequately protected.

Aside from naturally occurring uranium, the only radionuclide we consistently detected in water samples from production wells or test wells within the regional aquifer is tritium, which is found at trace levels. We have found tritium contamination at four locations in Los Alamos and Pueblo Canyons and one location in Mortandad Canyon. The tritium levels measured range from less than 2% to less than 0.01% of current drinking water standards, and all are below levels detectable by the EPA-specified analytical methods normally used to determine compliance with drinking water regulations.

Other measurements of radionuclides above detection limits in the regional aquifer reflect occasional analytical outliers not confirmed by analysis of subsequent samples.

Nitrate concentrations in TW-1 have been near the EPA MCL since 1980. The source of the nitrate might be infiltration of sewage-effluent-contaminated shallow groundwater and surface water in Pueblo Canyon or residual nitrates from the now decommissioned TA-45 radioactive liquid waste treatment plant that discharged effluents into upper Pueblo Canyon until 1964.

b. Surface Water and Alluvial Groundwater in Mortandad Canyon. Figure 5-13 depicts long-term trends of radionuclide concentrations in surface water and shallow alluvial groundwater in Mortandad Canyon downstream from the outfall for the RLWTF at TA-50. Because of strong adsorption to sediments, cesium-137 is not detected in groundwater samples. The figure only shows radionuclide detections. If more than one sample was collected in a year, the average value for the year is plotted. The surface water samples are from the station Mortandad at GS-1, a short distance downstream of the TA-50 effluent discharge. Radioactivity levels at this station vary daily depending on whether individual samples are collected shortly after a release from the RLWTF. These samples also vary in response to changes in amount of runoff from other sources in the drainage. The groundwater samples are from observation well MCO-5 in the middle reach of the canyon. Groundwater radioactivity at MCO-5 is more stable than at Mortandad at GS-1 because groundwater responds more slowly to variations in runoff water quality.

Chemical reactions such as adsorption do not delay tritium transport, and high tritium activities are found throughout the groundwater within the Mortandad Canyon alluvium. The tritium level in MCO-5 in 1999 was above the EPA MCL of 20,000 pCi/L. The surface water tritium activity at Mortandad at GS-1 reflects diluted values of effluent from TA-50 as the effluent mixes with other stream water. The tritium activity at MCO-5 has fluctuated almost in direct response (with a time lag of about one year) to the average annual activity of tritium in the TA-50 outfall effluent. Tritium values at both stations have decreased since the mid-1980s because of decreased tritium content of the TA-50 effluent.

The americium-241 activity of RLWTF discharges has exceeded the DOE DCG for public dose of 30 pCi/L for all but four years since 1973. Americium-241 activity has not been measured regularly at monitoring stations in Mortandad Canyon. Under many environmental conditions, americium is less strongly adsorbed than cesium or strontium and moves more readily in groundwater. The americium-241 activity in the observation wells was below the DOE drinking water DCG of 1.2 pCi/L. Data for the last four years at Mortandad at GS-1 show an increase in americium-241 activity to near the DOE DCG for public dose, but the value decreased in 1999. At MCO-5, the americium-241 activity shows only a slight increase over the past few years.

We detected plutonium isotopes at Mortandad at GS-1, MCO-3, and MCO-7.5 in 1999 but at no other alluvial observation wells. Both isotopes have been detected at Mortandad at GS-1 and MCO-3 at levels near the DOE public dose DCGs (30 pCi/L for plutonium-239, -240 and 40 pCi/L for plutonium-238) over the past few years. Values at other alluvial observation wells except for MCO-4 and MCO-7.5 have been near the detection limit in the 1990s. Plutonium has in general been detected in all alluvial observation wells in Mortandad Canyon but appears to be decreasing in activity at downstream locations. We last detected plutonium-238 in MCO-8 in 1976 and in MCO-7 and MCO-7.5 in 1985. Plutonium-239, -240 was last detected in MCO-8 in 1969, MCO-7.5 in 1987, and MCO-7 and MCO-7A in 1995.

E. Groundwater and Sediment Sampling at San Ildefonso Pueblo

To document the potential impact of Laboratory operations on lands belonging to San Ildefonso Pueblo, DOE entered into a Memorandum of Understanding (MOU) with the Pueblo and the Bureau of Indian Affairs in 1987 to conduct environmental sampling on pueblo land. This section deals with hydrologic and sediment sampling. Figures 5-14 and 5-15 show the groundwater, surface water, and sediment stations sampled on San Ildefonso Pueblo. Aside from stations shown on those figures, the MOU also specifies collection and analysis of additional water and sediment samples from sites that have long been included in the Laboratory's Environmental Surveillance Program, as well as special sampling of storm runoff in Los Alamos Canyon. These locations appear in Figures 5-1, 5-2, 5-3, 5-5, and 5-10. We discuss the results of these analyses in previous sections. Some sediment samples were collected in 1999 during sampling with the EPA in December. The locations of these samples are shown in Figure 5-8, and we discuss the results in Section 5.C.

1. Groundwater

Table 5-16 lists the results of radiochemical analyses of groundwater samples for 1999. As discussed in Section 5.F, the analytical laboratory had data quality problems with analysis of strontium-90 for 1999. Therefore, the strontium-90 data are presented in a separate table, Table 5-17. LANL strontium-90 values fall into two groups—regular and low-level analyses. Where NMED split sample data are available, we present them for comparison.

To emphasize values that are detections, Tables 5-18 and 5-19 list radionuclides detected in groundwater samples. Detections are defined as values exceeding both the analytical method detection limit and three times the individual measurement uncertainty. The analytical laboratory determined analysis-specific detection limits for many radiochemical measurements in 1999, which are listed in Tables 5-18 and 5-19. They did not provide individual detection limits for gross alpha, gross beta, or uranium. Because uranium, gross alpha, and gross beta are almost always detected, we indicate in Table 5-18 only occurrences of these measurements above threshold values. The specific levels are 5 µg/L for uranium, 5 pCi/L for gross alpha, and 20 pCi/L for gross beta and are lower than the EPA MCLs or screening levels.

The righthand columns of Tables 5-18 and 5-19 indicate radiochemical detections that are greater than 1/25 of the DOE DCGs for public dose for ingestion of environmental water (1/25 of the DOE DCG for Public Dose is the DOE drinking water system DCG).

The EPA drinking water limits for gross alpha and gross beta values are higher than 1/25 of the DOE public dose DCG (that is, greater than the DOE drinking water system DCGs), so we use the EPA values to screen gross alpha and gross beta values. The DCG value for gross beta is actually the strontium-90 DCG, and the DCG for gross alpha is the plutonium-239, -240 DCG. These DCGs were chosen because the isotopes represented had the lowest DCGs for alpha and beta emitters. No groundwater values exceeded half the DOE public dose DCG values in 1999.

See Section 5.D for a discussion of most of the groundwater stations (wells and springs) listed in the MOU. The present section focuses on the San Ildefonso Pueblo water supply wells.

As in previous years, the groundwater data for San Ildefonso Pueblo indicate the widespread presence of naturally occurring uranium at levels approaching or in excess of proposed EPA drinking water limits. Naturally occurring uranium concentrations near or even much greater than the proposed MCL of 20 µg/L are prevalent in well water throughout the Pojoaque area and San Ildefonso Pueblo. The high gross alpha readings for these wells are related to uranium occurrence.

In 1999, we did not detect radionuclides other than uranium in San Ildefonso Pueblo water supply wells. In previous years, San Ildefonso Pueblo water supply well data have suggested the occasional detection of trace levels of plutonium and americium. In most cases, these values are near the detection limit of the analytical method so that it is uncertain whether detection has occurred. At such measurement levels, precise quantification of the amount detected is not possible.

New Community Well again had a uranium concentration exceeding the proposed EPA primary drinking water standard of 20 µg/L. Uranium concentrations at the Don Juan Playhouse and Sanchez House Wells were more than half of the proposed EPA standard. Pajarito Pump 1 has had similar values but because of a high analytical uncertainty, the 1999 uranium value was not a detection. These measurements are consistent with the levels in previous samples and with the relatively high levels of naturally occurring uranium in other wells and springs in the area.

The gross alpha levels in these wells are attributable to the presence of uranium. The gross alpha values in the wells were above the EPA primary drinking water standard of 15 pCi/L but were not detections because of high analytical uncertainties. This standard applies to gross alpha from radionuclides other than radon and uranium.

Analytical laboratory problems caused many apparent detections of strontium-90 where it has not been seen previously. A value of strontium-90 exceeding the drinking water MCL of 8 pCi/L was apparently detected in Sanchez House Well. Strontium-90 was also detected in San Ildefonso Pueblo water supply wells LA-5, Don Juan Playhouse Well, Pajarito Well (Pump 1), and Eastside Artesian Well. LANL believes that none of these detections are valid, and that they are due to analytical laboratory problems. The NMED split samples collected at LA-5 and Sanchez House Well, which show no detection of strontium-90, support this conclusion.

The chemical quality of the groundwater, shown in Table 5-20, is consistent with previous observations. The sample from the Pajarito Pump 1 Well exceeded the drinking water standard for total dissolved solids; this level is similar to those previously measured. This well also has a chloride concentration at 70% of the New Mexico Groundwater Limit.

The fluoride values for some wells (Eastside Artesian and Sanchez House) are near the NMWQCC Groundwater Standard of 1.6 mg/L, similar to previous values. Several of the wells (Eastside Artesian and Don Juan Playhouse) have alkaline pH values above the EPA secondary standard range of 6.8 to 8.5; these values do not represent a change from those previously observed in the area.

Many of the wells have sodium values significantly above the EPA health advisory limit of 20 mg/L. The values from Pajarito Pump 1, Sanchez House, and Eastside Artesian Wells are especially high.

Table 5-21 shows trace metal analyses. The boron value in Pajarito Pump 1 was nearly twice the NMWQCC Groundwater Limit of 750 µg/L. This value was similar to those of past years.

2. Sediments

We collected sediments from San Ildefonso Pueblo lands in Mortandad Canyon in 1999 from several stations. The results of radiochemical analysis of sediment samples collected in 1999 appear in Table 5-10. As discussed in Section 5.F, the analytical laboratory had data quality problems with analysis of strontium-90 for 1999. Therefore, the strontium-90 data are presented in a separate table, Table 5-11. To emphasize values that are detections, Tables 5-12 and

5-13 list radiochemical detections for values that are higher than background levels and also identify values that are near or above SALs. Tritium has no established background value for sediments, so all tritium detections are shown in Table 5-12. Detections are defined as values exceeding both the analytical method detection limit and three times the individual measurement uncertainty. The analytical laboratory determined analysis-specific detection limits for many radiochemical measurements in 1999, which are listed in Tables 5-3 and 5-4. They did not provide individual detection limits for gross alpha, gross beta, or uranium. Because of analytical laboratory delays, many sediment stations did not have results completed for plutonium-238; plutonium-239, -240; and americium-241 in time for this report. Section 5.C presents related information. Results are comparable to sediment data collected from these same stations in previous years; exceptions are discussed below.

All sediment stations in Mortandad Canyon on San Ildefonso Pueblo lands showed only background activities of radionuclides. Sediments from the sampling station located on San Ildefonso Pueblo lands at Los Alamos at Otowi again showed the activity of plutonium-239, -240 as nearly twice background. This activity is slightly less than typical sediment samples previously collected at that station.

F. Sampling Procedures, Analytical Procedures, Data Management, and Quality Assurance

1. Sampling

The Draft Quality Assurance Project Plan (ESH-18 1996) is the basic document covering sampling procedures and quality assurance (QA). The formal procedures developed to address sampling for each sample matrix (Mullen and Naranjo 1996, 1997) provide more focused guidance. All sampling is conducted using strict chain-of-custody procedures, as described in Gallaher (1993). The completed chain-of-custody form serves as an analytical request form and includes the requester or owner, sample barcode number, program code, date and time of sample collection, total number of bottles, the list of analytes to be measured, and the bottle sizes and preservatives for each analysis required. We send the samples to the Chemical Science and Technology (CST) Division or to other analytical laboratories. Detailed analytical methods are published in Gautier (1995). We submit samples using blind sample numbers to prevent possible bias that might occur if the analyst knows the sampled location.

We filtered in the field samples collected for radionuclide and metals analysis at the White Rock Canyon Springs to minimize the effects of surface soils and to represent groundwater surfacing at the springs. The “F/UF” column on the tables of analytical results shows a “UF” for unfiltered samples and an “F” for samples filtered through a 0.45-micron filter.

We filtered in the field surface water samples collected for metals analysis. This procedure allows for comparison of analytical results with the NMWQCC standards. These standards are mainly for dissolved concentrations, except mercury and selenium, for which standards are based on total concentrations. Mercury and selenium were not filtered in the field and were analyzed to determine total concentration.

Automated samplers located at recently installed gaging stations (Shaull et al., 1999) collected runoff. The contents of bottles collected by the automated sampler were first transferred to a churn splitter, which agitates the samples to ensure that they are well mixed and that the sediments are suspended. If the automated sampler collected adequate water, we submitted two sets of samples to the analytical laboratory. One set was unfiltered and preserved for total concentration analysis, whereas the other set was submitted unfiltered and unpreserved. The analytical laboratory filtered the latter samples, preserved them, and routed them to the appropriate analyst. If insufficient water was available, only unfiltered samples were analyzed to determine total concentrations.

2. Analytical Procedures

a. Metals and Major Chemical Constituents. Metals and major chemical constituents are analyzed using EPA SW-846 methods. Filtering in the analytical laboratory and digestion methods (breaking down the solids by acid) have changed over time. Before 1993, water samples were preserved in the field and filtered in the laboratory before digestion. From 1993 forward, the analytical laboratory has not filtered water samples submitted for metals analyses, with the exception of runoff samples as mentioned above.

b. Radionuclides. Radiochemical analysis is performed using the methods as updated in Gautier (1995). Sediment samples are screened through a number 12 US standard testing sieve before digestion. The sieve meets ASTM E-11 specifications and screens out materials larger than 1.7 mm. Ten-g samples are analyzed from stream channels; larger 1,000-g samples are analyzed from reservoirs for plutonium-238 and plutonium-239, -240. Larger 1,000-g samples give a 10-fold improvement in detection limits of plutonium-238 and plutonium-239, -240 for reservoir samples.

We preserve water samples for radiochemical analyses with nitric acid in the field to a pH of 2 or less. Before 1996, the analytical laboratory filtered water samples before digesting. Samples collected in 1996 and after are preserved in the field as before but the analytical laboratory does not filter them. At the analytical laboratory, both water and sediment samples are completely digested in a mixture of nitric and hydrofluoric acids. We collect a separate, unpreserved sample for tritium analysis.

When especially precise trace-level tritium analyses are required, we ship samples to the University of Miami Tritium Laboratory. These samples are collected and analyzed according to procedures described in Tritium Laboratory (1996).

Negative values are reported for some radiological measurements. Negative numbers occur because measurements of radiochemical samples require that analytical or instrumental backgrounds be subtracted to obtain net values. Consequently, individual measurement values can result in positive or negative numbers. Although negative values do not represent a physical reality, we report them as they are received from the analytical laboratory. Valid long-term averages can be obtained only if negative values are included in the analytical results.

c. Organics. Organics are analyzed using SW-846 methods as shown on Table A-9. This table shows the number of analytes included in each analytical suite. Tables A-10 through A-13 list the specific compounds that are analyzed in each suite. All organic samples are collected in brown glass bottles, and the VOC samples are preserved with hydrochloric acid. A trip blank, or field blank, always accompanies the VOC sample. A trip blank is a sample of de-ionized water that accompanies the field samples and is submitted for analysis like any other sample. The analytical laboratory prepares method blanks and also analyzes them with samples. If trip or method blanks contain organic compounds, they were introduced during sampling or analytical procedures. Certain organic compounds used in analytical laboratories are frequently detected in the method blanks. These compounds include acetone, methylene chloride, toluene, 2-butanone, di-n-butyl phthalate, di-n-octyl phthalate, and bis (2-ethylhexyl) phthalate (Fetter 1993).

3. Data Management and Quality Assurance

a. Data Management. CST transfers analytical results to the Water Quality and Hydrology Group (ESH-18) both electronically and as a hard copy. Samples submitted to CST go through the SQL Laboratory Information Management System. A data retrieval query generates a table of ESH-18 data every week. The data set is downloaded to ESH-18 computers every week. The sample location name, the sample number, and the field data are stored in a separate table, providing the link for associating a blind sample number with a location name.

b. Strontium-90 Data for 1999. Because of concern about possible presence of strontium-90 in water samples from the regional aquifer, in 1998 ESH-18 requested CST-9 to find a new analytical technique with a lower detection limit. They instituted a new technique for 1999 strontium-90 samples. Once 1999 analytical results became available, ESH-18 determined that numerous analytical values for strontium-90 were probably significantly in error. Based on comparison with previous data for particular stations, comparison with data obtained by the NMED Oversight Bureau, and review of analytical laboratory results and procedures, ESH-18 concluded that the entire strontium-90 data set for surface water, runoff, groundwater, and sediments for 1999 is not valid.

The data at every location for 1999 are questionable, and this represents the loss of an entire year's monitoring data. We present the data in this report for documentary purposes only. Taken at face value, the 1999 strontium-90 values would indicate unusually high levels in sediments, surface water, and groundwater. LANL has resolved the analytical laboratory problems and will continue monitoring strontium-90 in 2000.

Results in Table 5-24 show a high analytical bias for strontium-90. Ideally, the values for the blanks should be zero; strontium-90 was detected in several of the blanks. Table 5-24 also shows the reported concentrations of strontium-90 in the spiked samples. The reported concentrations range from about 15% to 90% of the actual spiked concentration.

ESH-18 questioned the analytical results that indicated the presence of strontium-90 in a number of water samples. The levels of strontium-90 could not be confirmed with reanalysis of a portion of those same samples. A Corrective Action Request (CAR) was initiated so that a thorough investigation could examine potential problems associated with the data sets in question. CST-9 wrote the draft CAR and dated it August 10, 2000. The CAR concludes that the analytical method, which employs selective extraction resins, may not be adequate for analysis of strontium-90 in the samples submitted for analysis.

A review of the analytical laboratory's data packages and standard operating procedures by the DOE Analytical Management Program, dated August 6, 2000, indicated several problems with the analyses that "very likely…result in erroneously high strontium-90 results." The DOE review points out operating procedures involving the extraction efficiencies of the resins that could lead to deleterious effects on resulting strontium-90 data. That review also outlined several other reasons for erroneous strontium-90 results.

c. Quality Assurance. Each analytical batch of water samples (20 samples or less) contains at least one blank, one matrix spike, and a duplicate as dictated by SW-846 protocols. CST provides these quality control samples and submits them along with environmental surveillance samples. ESH-18 also submits blanks, spikes, and duplicate water samples. Tables 5-25 and 5-26 present the analytical results of the blanks and spikes. The analytical results for the duplicates are presented on the analytical result tables. No quality control samples were submitted for sediment analysis.

ESH-18 submits DI trip blanks and spiked samples as regular samples, without any indication that they are QC samples. They go through the same analytical process as the regular field samples. The DI blanks and spiked samples are measured with the same background contributions from reagents and biases as the regular samples and give an estimate of background and systematic analytical errors.

We also submit trip blanks to detect if any organics are inadvertently introduced during the sampling or analytical laboratory procedures.

Results in Table 5-25 show a high analytical bias of several analytes. Ideally, the values for all analytes in the blanks should be zero. A high bias of 20% of the detection limit is apparent in the uranium DI blank results. A high bias of 25% and 35%, respectively, is apparent in the plutonium-238 and plutonium-239 DI blank results, and a high bias of 50% is observed in the americium-241 DI blanks during the analysis procedure. The likely causes for the unaccounted for concentrations for americium-241 are the plutonium-242 and americium-247 tracers that are added to each sample. Both of those tracers contain americium-241.

The concentrations reported in Table 5-25 for the spiked samples are the concentrations after subtraction of the average blank values. For plutonium-238 the agreement is good, relative to their respective detection limits, between the analytical results and the spiked concentrations after blank correction. The indicated activity of plutonium-239 in the DI blanks was nearly 20% more than the actual spiked concentration, and americium-241 was 30% greater.

Taylor (1987) suggests a method for evaluating detection limits based on the analytical results for spiked samples. The standard deviation of the average spiked sample result can be used as a measure of the one sigma analytical uncertainty. Results of this analysis are presented in the last two lines on Table 5-25. Detection limits calculated using this method are nearly identical to the values the analytical laboratory reported for cesium-137, plutonium-238, and plutonium-239. The calculated detection limit for americium-241 is nearly twice as high as the laboratory detection limit.

Analytical concentrations for DI blanks submitted for trace metals were generally reported as less-than-detection limits. Spiked samples for metals analyses contained four metals: silver, barium, mercury, and lead. The agreement between the spiked concentration of barium and the analytical results was generally good. The spiked concentrations of mercury and silver were, respectively, 21% and 28% less than their spiked concentrations. Standard deviations associated with the average values of barium and mercury for the DI blanks and spiked samples were significantly less than the reported concentrations, suggesting relatively precise measurements for those analytes.

QA samples were spiked with lead at a concentration of 7.5 µg/L. The analytical laboratory, however, did not report lead concentrations of less than 60 µg/L.

4. Determination of Radiochemical Detections

CST has determined detection limits for each analytical method. Radiological detection limits are based on Currie's formula (Currie 1968). Detection limits appear at the bottom of the tables summarizing the radiochemical analytical results. In deriving the detection limits, CST included the average uncertainties associated with the entire analytical method. Sources of error considered include average counting uncertainties, sample preparation effects, digestion, dilutions, gravimetric and pipetting uncertainties, and spike recoveries.

While these method detection limits determined by CST or other analytical laboratories give an idea of the average limit of detection for a particular measurement technique, the detection limits do not apply to each individual sample measurement. Instead, the question of whether or not an individual measurement is a detection is evaluated in light of its individual measurement uncertainty. For radiochemical analytical results, the analytical uncertainties are reported in the tables. These uncertainties represent a one standard deviation (one sigma) propagated uncertainty. “It is virtually unanimously accepted that an analyte should be reported as present when it is measured at a concentration three-sigma or more above the corresponding method blank.” (Keith 1991) Our reported values are corrected by blank subtraction to eliminate the effects of positive or negative analytical laboratory biases. Therefore, we report radiochemical detections as values greater than three times the reported uncertainty. For sediments, the values reported as detections in the table are also above background levels determined for fallout (or natural background levels in the case of uranium).

The limit of quantification or LOQ is the level where the concentration of an analyte can be quantified with confidence. “When the analyte signal is 10 or more times larger than the standard deviation of the measurements, there is a 99% probability that the true concentration of the analyte is ±30% of the calculated concentration.” (Keith 1991) Thus, measured values near the detection limit or less than 10 times the analytical uncertainty do not provide a reliable indication of the amount present. The importance of this number is demonstrated when analytical results are compared against standards; the analytical result should be greater than 10 times the analytical uncertainty for the comparison to be meaningful.

G. Unplanned Releases

ESH-18 investigated all unplanned releases of nonradioactive liquid. Upon cleanup, personnel from NMED-DOE/OB (Oversight Bureau) inspected the unplanned release site to ensure adequate cleanup. NMED-DOE/OB recommended administrative closure of five of the six unplanned releases that occurred in 1999. It is anticipated that the other unplanned release investigation will be closed when NMED-DOE/OB personnel become available for inspections.

1. Radioactive Liquid Materials

No unplanned radioactive liquid releases occurred in 1999.

2. Nonradioactive Liquid Materials

There were six unplanned releases of nonradioactive liquid in 1999. The following is a summary of these discharges.

- Three unplanned releases of potable water that impacted a solid waste management unit or potential release site.
- Two unplanned releases of sanitary sewage from the Laboratory’s TA-46, SWS Facility’s collection system.
- One unplanned release of steam condensate to a solid waste management unit or potential release site.

H. Special Studies

Surface water discharge data were collected from approximately 50 stream-gaging stations that cover most of the Laboratory. Gaging stations with discharge rating data published in the report “Surface Water Data at Los Alamos National Laboratory: 1999 Water Year” (Shaull et al., 2000), show less runoff than do data for the 1998 water year. Water chemistry data from storm events occurring at some stations are also published in the Laboratory’s annual environmental surveillance report, not in the Surface Water Data report.

The annual water data report from LANL contains flow data. The data collection focused on the Laboratory’s downstream boundary, close to State Road 4; the upstream boundary is approximated by State Road 501 and stations located within the Laboratory. Station data is only published for gages that have been rated. Group ESH-18, along with the USGS Water Resources Division, developed and installed the initial nine-station stream-gaging network and designed and installed the necessary data collection structures. This network has grown to 61 stations and is operated and maintained by the Storm Water Team of ESH-18.

Table 5-1. Radiochemical Analysis of Surface Water and Runoff Samples for 1999 (pCi/L[a])

Station Name	Date	Matrix[b]	Code[c]	F/UF[d]	^{3}H		^{137}Cs		U (µg/L)		^{238}Pu		$^{239, 240}$Pu		^{241}Am		Gross Alpha		Gross Beta		Gross Gamma	
Regional Stations																						
Rio Chama at Chamita	06/16	SW	1	UF	–20	590	0.28	0.68	1.21	0.05	0.008	0.007	0.003	0.010	0.063	0.015	2.6	2.1	3.4	2.4	66	51
Rio Chama at Chamita	06/16	SW	1D	UF					1.10	0.11												
Rio Chama at Chamita	06/16	SW	2	UF	170	610	0.92	0.86	1.17	0.07	0.015	0.007	0.014	0.008	0.036	0.010	2.2	2.0	3.2	2.3	70	51
Rio Chama at Chamita	06/16	SW	2D	UF					1.07	0.11												
Rio Grande at Embudo	10/05	SW	1	UF	0	600	0.42	0.70	1.50	0.30	0.002	0.010	0.017	0.010	0.009	0.005	2.1	1.4	3.9	2.8	39	49
Rio Grande at Otowi Upper (bank)	08/03	SW	1	UF	–20	610	0.57	1.05	2.24	0.22	0.025	0.018	0.008	0.010	–0.024	0.075	19.2	8.6	32.7	13.9	154	51
Rio Grande at Otowi Upper (bank)	08/03	SW	1D	UF					2.60	0.30												
Rio Grande at Otowi (bank)	08/03	SW	1	UF	–130	610	2.51	1.99	2.54	0.25	0.007	0.008	0.016	0.010	–0.004	0.003	12.9	5.3	20.1	7.9	184	51
Rio Grande at Otowi (bank)	08/03	SW	1D	UF					3.00	0.20												
Rio Grande at Frijoles (bank)	09/22	SW	1	UF	–10	610	0.00	7.29	2.00	0.20	–0.003	0.008	0.010	0.008	0.021	0.008	3.9	2.0	6.4	3.2	45	49
Rio Grande at Frijoles (bank)	09/22	SW	2	UF	320	630	0.00	10.00	1.70	0.10	0.001	0.010	0.005	0.007	–0.012	0.008	5.7	3.3	7.5	5.5	34	48
Rio Grande at Cochiti	09/23	SW	1	UF	160	620	–0.92	7.37	2.10	0.10	0.004	0.006	0.003	0.012	0.005	0.003	6.0	3.4	9.2	5.7	39	49
Jemez River	08/02	SW	1	UF	–50	610	1.81	1.36	1.53	0.15	0.021	0.013	0.033	0.014	0.001	0.002	12.6	5.2	18.0	7.5	154	51
Jemez River	08/02	SW	1D	UF					1.50	0.20												
Jemez River	08/02	SW	2	UF	50	620	0.00	7.41	1.34	0.13	–0.017	0.021	0.006	0.015	0.039	0.011	14.5	6.6	16.0	9.0	90	51
Jemez River	08/02	SW	2D	UF					1.40	0.30												
Pajarito Plateau																						
Guaje Canyon:																						
Guaje Canyon	11/16	SW	1	UF	–50	580	–0.60	2.90	–0.14	0.05	0.004	0.013	0.013	0.010	0.007	0.004	0.3	2.2	1.6	1.5	6	49
Acid/Pueblo Canyon:																						
Acid Weir	06/23	SW	1	UF	220	610	0.00	7.91	0.20	0.70	0.003	0.015	0.528	0.045	0.033	0.009	1.3	1.3	19.9	5.8	111	52
Pueblo 1	06/23	SW	1	UF	230	610	1.36	1.26	–0.02	0.70	0.018	0.014	0.035	0.015	–0.008	0.006	7.3	3.0	16.6	5.1	133	52
Pueblo 3	05/20	SW	1	UF	20	590	1.46	1.21	0.30	0.05	0.004	0.017	0.037	0.016	–0.010	0.030	1.6	2.8	11.6	6.7	63	51
Pueblo 3	05/20	SW	1D	UF					0.51	0.05												
Pueblo at SR-502	08/03	SW	1	UF					0.04	0.05												
Pueblo at SR-502	08/04	SW	1	UF	150	630	2.38	1.51	0.34	0.03	0.011	0.009	0.129	0.020	0.015	0.006	1.1	1.2	16.2	9.0	175	51
Pueblo at SR-502	08/04	SW	1D	UF					0.05	0.05												
Pueblo at SR-502	12/01	SW	1	UF	–130	590	–0.95	5.67	0.20	0.10	0.007	0.010	0.006	0.014	0.016	0.006	0.7	8.6	13.6	6.5	25	49
DP/Los Alamos Canyon:																						
Los Alamos Canyon Reservoir	06/23	SW	1	UF	30	600	–0.22	4.97	0.05	0.70	0.010	0.011	–0.004	0.005	0.010	0.004	0.9	1.1	6.4	3.0	150	52
Los Alamos at Upper Gaging Station	05/26	SW	1	UF	–50	590	0.00	5.88	0.24	0.02	0.001	0.005	0.051	0.015	0.026	0.010	1.3	1.8	3.7	2.6	145	51
Los Alamos at Upper Gaging Station	05/26	SW	1D	UF					0.10	0.05												

Table 5-1. Radiochemical Analysis of Surface Water and Runoff Samples for 1999 (pCi/L[a]) (Cont.)

Station Name	Date	Matrix[b]	Code[c]	F/UF[d]	^{3}H		^{137}Cs		U (µg/L)		^{238}Pu		$^{239, 240}$Pu		^{241}Am		Gross Alpha		Gross Beta		Gross Gamma	
Pajarito Plateau (Cont.)																						
Sandia Canyon:																						
SCS-1	05/27	SW	1	UF	140	600	–1.14	3.71	0.80	0.10	0.004	0.007	0.023	0.011	0.024	0.014	2.6	4.3	20.7	9.2	30	50
SCS-2	05/19	SW	1	UF	90	600	0.36	0.25	0.90	0.30	0.003	0.007	0.002	0.007	0.036	0.013	0.4	7.3	17.6	9.6	195	51
SCS-2	05/19	SW	1D	UF					0.83	0.08												
SCS-3	06/16	SW	1	UF	340	620	0.00	7.14	0.56	0.08	0.208	0.034	0.022	0.012	0.032	0.011	2.4	3.8	10.5	6.1	86	51
SCS-3	06/16	SW	1D	UF					0.43	0.04												
Mortandad Canyon:																						
Mortandad at Gaging Station 1	05/27	SW	1	UF	2,480	760	28.63	3.54	1.21	0.12	8.108	0.250	3.757	0.140	4.438	0.154	27.5	9.1	81.6	19.9	133	51
Mortandad at Gaging Station 1	05/27	SW	1D	UF					1.40	0.60												
Mortandad at Rio Grande (A-11)	09/20	SW	1	UF	–20	610																
Mortandad at Rio Grande (A-11)	09/21	SW	1	UF			–1.50	6.98			–0.001	0.008	0.005	0.006	–0.001	0.002	0.6	0.9	13.8	6.6	19	48
Pajarito Canyon:																						
Pajarito at Rio Grande	09/21	SW	1	UF	150	620	0.00	7.65	1.00	0.10	0.008	0.012	0.037	0.014	0.030	0.010	1.6	1.2	5.3	3.0	9	48
Water Canyon:																						
Water Canyon at Beta	11/17	SW	1	UF	–60	580	0.11	1.00	–0.09	0.05	–0.002	0.004	–0.001	0.007	0.017	0.006	0.3	3.2	2.8	1.6	44	49
Ancho Canyon:																						
Ancho at Rio Grande	09/21	SW	1	UF	0	610	0.00	5.59	0.30	0.10	0.022	0.010	0.009	0.007	0.020	0.007	0.7	0.7	3.3	2.7	77	49
Frijoles Canyon:																						
Frijoles at Monument Headquarters	12/22	SW	1	UF	–60	580	1.38	1.25	1.90	0.40	0.012	0.011	0.001	0.006	–0.005	0.004	–0.3	0.7	1.1	1.4	72	49
Frijoles at Rio Grande	12/22	SW	1	UF	50	590	0.00	4.70	2.60	0.40	0.012	0.008	0.016	0.011	0.012	0.005	0.4	0.5	1.7	1.5	286	50
Runoff Stations																						
Perimeter:																						
LA Canyon near Los Alamos	04/30	RO/D	1	F			0.93	0.18	0.16	0.05	0.016	0.009	0.033	0.009	0.083	0.026	1.5	1.1	10.7	2.3	80	51
LA Canyon near Los Alamos	04/30	RO/TOT	1	UF	100	640	4.02	0.40			0.106	0.028	1.787	0.101	9.466	0.411	81.8	17.1	85.2	10.1	84	51
LA Canyon near Los Alamos	05/03	RO/D	1	F			–0.17	1.92			0.004	0.011	0.038	0.019	0.045	0.016	1.4	1.0	8.5	2.2	130	52
LA Canyon near Los Alamos	05/03	RO/TOT	1	UF	120	620	1.81	0.36	1.40	0.10	0.184	0.038	1.568	0.116	0.939	0.086	18.1	4.3	14.9	3.7	58	51
LA Canyon near Los Alamos	07/08	RO/D	1	F			1.02	0.83			–0.014	0.020	0.047	0.025	0.025	0.010	1.0	1.2	12.6	4.1	74	52
LA Canyon near Los Alamos	07/08	RO/TOT	1	UF			42.27	5.04			1.531	0.122	15.778	0.638	7.393	0.240	160.0	48.7	191.0	55.1	130	52
LA Canyon near Los Alamos	07/13	RO/D	1	F					–0.10	0.70												
LA Canyon near Los Alamos	07/13	RO/TOT	1	UF					8.20	0.70												
LA Canyon near Los Alamos	08/09	RO/D	1	F			0.00	6.20	2.02	0.20	0.052	0.022	0.028	0.016	0.003	0.002	1.4	1.3	9.3	3.6	54	50
LA Canyon near Los Alamos	08/09	RO/D	1D	F					0.14	0.06												
LA Canyon near Los Alamos	08/09	RO/TOT	1	UF	–220	600	10.32	2.53	7.33	0.73	0.222	0.040	2.471	0.149	2.921	0.187	507.0	181.0	536.0	196.0	142	51
LA Canyon near Los Alamos	08/09	RO/TOT	1D	UF					4.10	0.70												

Table 5-1. Radiochemical Analysis of Surface Water and Runoff Samples for 1999 (pCi/L[a]) (Cont.)

Station Name	Date	Matrix[b]	Code[c]	F/UF[d]	^{3}H		^{137}Cs		U (µg/L)		^{238}Pu		^{239,240}Pu		^{241}Am		Gross Alpha		Gross Beta		Gross Gamma	
Runoff Stations (Cont.)																						
Perimeter: (Cont.)																						
LA Canyon near Los Alamos	08/10	RO/D	1	F			–0.56	8.49			0.023	0.015	0.112	0.023	0.069	0.019	2.5	1.7	12.3	4.2	107	51
LA Canyon near Los Alamos	08/10	RO/TOT	3	UF			7.23	1.48	3.50	0.70	0.220	0.040	5.291	0.235	3.038	0.148	70.2	28.8	90.6	34.5	103	51
LA Canyon below TA-2	09/16	RO/D	1	F			–1.74	7.62	0.00	0.06	0.007	0.007	0.040	0.017	0.082	0.047	–0.1	0.5	1.2	1.5	53	48
LA Canyon below TA-2	09/16	RO/TOT	1	UF			1.00	1.10	4.30	0.30	0.173	0.036	6.298	0.289	0.220	0.037	111.0	40.8	77.9	34.9	145	49
DP Canyon near Los Alamos	06/23	RO/D	1	F			1.09	0.83	–0.20	0.70	0.009	0.009	0.030	0.013	0.043	0.011	1.0	1.3	18.2	5.3	21	51
DP Canyon near Los Alamos	06/23	RO/TOT	1	UF	80	600	22.01	2.87	3.00	1.00	0.645	0.085	2.928	0.201	7.362	0.336	165.0	49.9	282.0	73.3	130	52
DP Canyon near Los Alamos	08/14	RO/TOT	1	UF			5.36	1.39	1.19	0.12	0.062	0.019	0.962	0.076	2.576	0.180	31.3	18.4	81.6	32.5	12	50
DP Canyon near Los Alamos	08/14	RO/TOT	1D	UF					1.11	0.09												
DP Canyon near Los Alamos	09/16	RO/TOT	1	UF			16.17	2.26	2.50	0.30	0.027	0.015	1.835	0.126	4.443	0.201	172.0	60.1	324.0	93.5	221	49
Sandia Canyon below Power Plant	05/28	RO/TOT	1	UF			–0.14	1.53	1.50	0.10	0.006	0.016	0.021	0.014	0.064	0.026	24.3	5.8	30.2	5.4	47	50
Sandia Canyon below Wetlands	07/12	RO/TOT	1	UF			1.28	0.91	1.60	0.70	1.183	0.079	0.018	0.011	0.017	0.013	29.6	10.6	36.0	12.0	34	52
Sandia Canyon below Wetlands	08/10	RO/TOT	1	UF			0.32	0.84	0.60	0.70	0.002	0.011	0.042	0.014	0.030	0.012	6.5	2.8	9.7	3.6	101	51
Sandia Canyon near Roads & Grounds at TA-3	05/28	RO/TOT	1	UF			–0.09	1.82	1.10	0.20	0.000	0.000	0.013	0.024	–0.003	0.003	19.6	4.9	25.8	4.9	66	51
Sandia Canyon near Roads & Grounds at TA-3	07/14	RO/TOT	1	UF			0.54	0.62	0.70	0.70	0.018	0.009	0.018	0.010	0.045	0.011	7.5	3.0	12.5	4.1	25	51
Sandia Canyon near Roads & Grounds at TA-3	08/10	RO/TOT	1	UF			0.56	1.20	1.20	0.70	0.008	0.015	0.044	0.017	–0.019	0.021	33.9	15.5	47.5	19.5	67	51
Sandia Canyon Truck Route	09/14	RO/TOT	1	UF			0.67	1.60	2.40	0.30	0.040	0.019	0.039	0.017	0.028	0.013	106.0	39.6	85.7	36.7	85	49
Cañada del Buey at White Rock	06/17	RO/D	1	F			0.00	8.58	0.17	0.02	0.009	0.010	0.019	0.012	0.074	0.019	0.1	25.3	1.8	20.0	106	51
Cañada del Buey at White Rock	06/17	RO/D	1D	F					0.10	0.70												
Cañada del Buey at White Rock	06/17	RO/TOT	1	UF	170	620	2.46	1.47	6.47	0.65	0.578	0.054	2.044	0.110	0.488	0.062	208.0	55.6	160.0	46.5	134	51
Cañada del Buey at White Rock	06/17	RO/TOT	1D	UF					0.90	0.70												
Cañada del Buey at White Rock	08/06	RO/TOT	1	UF			2.00	0.92	5.43	0.54	0.119	0.038	0.147	0.043	0.137	0.033	328.0	138.0	365.0	153.0	201	52
Cañada del Buey at White Rock	08/06	RO/TOT	1D	UF					11.50	0.50												
Cañada del Buey at White Rock	08/23	RO/TOT	3	UF			3.67	0.90	7.41	0.74	0.136	0.037	0.288	0.055	0.319	0.049	121.0	81.0	219.0	118.0	179	51
Cañada del Buey at White Rock	08/23	RO/TOT	3D	UF					14.00	1.00												
Cañada del Buey at White Rock	09/16	RO/TOT	1	UF			1.54	1.12	3.60	0.40	0.161	0.037	1.305	0.107	0.235	0.039	282.0	124.0	269.0	129.0	230	50
Pajarito Canyon above Threemile Canyon	09/16	RO/D	1	F			29.43	8.43	0.03	0.05	0.003	0.009	0.013	0.008	–0.033	0.204	1.1	1.0	2.1	1.7	74	48
Pajarito Canyon above Threemile Canyon	09/16	RO/TOT	1	UF			0.00	9.80	3.00	0.50	0.043	0.021	0.088	0.027	0.043	0.015	52.1	21.9	38.1	19.9	59	48
Pajarito Canyon above SR-4	06/17	RO/D	1	F			0.31	0.90	0.32	0.03	0.014	0.009	0.444	0.041	0.003	0.000	3.6	4.2	10.2	9.2	84	51
Pajarito Canyon above SR-4	06/17	RO/D	1D	F					0.10	0.70												
Pajarito Canyon above SR-4	06/17	RO/TOT	1	UF	140	620	1.24	1.55	1.45	0.15	0.100	0.031	1.565	0.109	7.853	0.238	56.2	19.1	31.2	14.1	83	51
Pajarito Canyon above SR-4	06/17	RO/TOT	1D	UF					1.30	0.70												
Potrillo Canyon near White Rock	08/31	RO/D	1	F			0.96	0.99	0.15	0.02	0.001	0.010	0.009	0.008	–0.001	0.006	0.7	0.8	3.0	2.0	119	49
Potrillo Canyon near White Rock	08/31	RO/D	1D	F					0.01	0.05												

Table 5-1. Radiochemical Analysis of Surface Water and Runoff Samples for 1999 (pCi/L[a]) (Cont.)

Station Name	Date	Matrix[b]	Code[c]	F/UF[d]	^{3}H		^{137}Cs		U (µg/L)		^{238}Pu		$^{239,240}Pu$		^{241}Am		Gross Alpha		Gross Beta		Gross Gamma	
Runoff Stations (Cont.)																						
Perimeter: (Cont.)																						
Potrillo Canyon near White Rock	08/31	RO/TOT	1	UF	90	610	3.85	1.22	4.76	0.48	0.047	0.031	0.431	0.067	0.085	0.023	9.6	3.4	16.4	5.0	470	51
Potrillo Canyon near White Rock	08/31	RO/TOT	1D	UF					2.30	0.40												
Potrillo Canyon near White Rock	09/16	RO/TOT	1	UF			3.67	2.41	3.90	0.40	0.006	0.012	0.091	0.033	0.055	0.017	109.0	45.1	102.0	46.1	147	49
North Fork Ancho Canyon at TA-39	09/16	RO/TOT	1	UF			1.64	1.48	8.80	0.90	0.050	0.015	0.137	0.025	0.196	0.033	241.0	113.0	267.0	129.0	159	49
Ancho Canyon at TA-39	07/27	RO/TOT	1	UF			6.51	1.64	4.60	0.50	0.060	0.021	0.207	0.040	0.308	0.210	247.0	114.0	257.0	127.0	83	50
Ancho Canyon at TA-39	08/04	RO/TOT	1	UF			5.57	1.83	14.00	1.00	0.037	0.033	0.314	0.061	0.314	0.076	505.0	175.0	1010.0	297.0	207	52
Ancho Canyon at TA-39	08/04	RO/TOT	1D	UF					6.30	0.63												
Ancho Canyon at TA-39	08/10	RO/TOT	3	UF			5.77	1.61	5.16	0.52	0.238	0.046	0.774	0.084	0.167	0.030	303.0	132.0	320.0	143.0	149	51
Ancho Canyon at TA-39	08/10	RO/TOT	3D	UF					12.60	0.40												
Ancho Canyon near Bandelier	06/18	RO/TOT	1	UF			5.59	1.03	170.00	20.00	0.075	0.043	0.775	0.102	0.399	0.058	504.0	181.0	829.0	251.0	162	52
Ancho Canyon near Bandelier	07/08	RO/D	1	F			0.24	1.11	–0.30	0.70	0.029	0.012	0.016	0.010	–0.004	0.003	0.8	1.1	3.8	2.4	89	52
Ancho Canyon near Bandelier	07/08	RO/TOT	1	UF	70	640	2.80	0.92	12.00	1.00	0.096	0.044	0.285	0.063	0.020	0.181	8.9	3.3	9.5	3.7	154	52
Ancho Canyon near Bandelier	07/27	RO/TOT	3	UF			12.49	2.27			0.000	0.000	0.000	0.000	0.000	0.000	465.0	166.0	596.0	215.0	315	52
Ancho Canyon near Bandelier	08/03	RO/TOT	1	UF					5.30	0.50												
Ancho Canyon near Bandelier	08/04	RO/TOT	3	UF					9.00	1.00												
Mesa Top:																						
TA-55	08/14	RO/D	1	F			–1.01	4.65	0.05	0.01	0.008	0.011	0.008	0.014	0.041	0.013	0.4	0.9	1.1	1.6	36	51
TA-55	08/14	RO/TOT	1	UF			0.00	5.45	0.07	0.01	0.015	0.016	0.024	0.020	0.045	0.015	2.0	1.5	4.2	2.3	25	51
TA-55	08/14	RO/TOT	1D	UF					–0.02	0.05												
Area L	08/14	RO/TOT	1	UF			3.67	0.90	0.07	0.01	–0.005	0.012	0.024	0.012	0.008	0.006	1.6	1.3	3.0	2.0	128	51
Area L	08/14	RO/TOT	1D	UF					–0.05	0.20												
Area G:																						
G-SWMS-1	07/29	RO/D	1	F			0.00	9.85	0.36	0.04	0.013	0.008	0.039	0.012	–0.009	0.005	0.4	1.1	5.8	2.9	49	51
G-SWMS-1	07/29	RO/D	1D	F					0.13	0.05												
G-SWMS-1	07/29	RO/TOT	1	UF	920	670	3.57	1.80	5.52	0.55	1.016	0.072	0.410	0.044	0.287	0.202	236.0	86.6	421.0	129.0	180	51
G-SWMS-1	07/29	RO/TOT	1D	UF					5.00	0.60												
G-SWMS-2	05/24	RO/TOT	1	UF	–30	610	1.54	0.35	4.40	0.90	0.107	0.027	1.284	0.096	0.220	0.046	256.0	51.4	195.0	22.6	52	51
G-SWMS-2	07/08	RO/TOT	1	UF			1.80	1.05	4.80	0.70	0.060	0.022	0.270	0.044	0.060	0.012	161.0	46.2	194.0	52.9	70	52
G-SWMS-2	07/29	RO/TOT	3	UF	1,120	680	26.64	4.29	2.30	0.40	0.088	0.021	0.302	0.038	0.721	0.216	128.0	41.0	129.0	44.9	199	52
G-SWMS-3	05/28	RO/TOT	1	UF			–0.17	1.76	9.00	1.00	0.370	0.047	1.930	0.116	1.001	0.085	72.1	15.1	59.7	7.6	199	52
G-SWMS-3	06/17	RO/TOT	1	UF			2.55	1.42			0.427	0.070	2.155	0.157	0.391	0.041	278.0	83.5	383.0	105.0	222	53
G-SWMS-3	07/15	RO/TOT	1	UF	290	610	2.10	0.92	9.00	1.00	0.976	0.124	3.064	0.243	1.060	0.113	429.0	128.0	504.0	143.0	191	53
G-SWMS-3	07/29	RO/D	1	F			1.28	1.17	0.60	0.10	–0.004	0.004	0.013	0.006	0.029	0.010	1.7	1.4	6.1	2.9	23	50

Table 5-1. Radiochemical Analysis of Surface Water and Runoff Samples for 1999 (pCi/L[a]) (Cont.)

Station Name	Date	Matrix[b]	Code[c]	F/UF[d]	^{3}H		^{137}Cs		U (μg/L)		^{238}Pu		^{239,240}Pu		^{241}Am		Gross Alpha		Gross Beta		Gross Gamma	
Runoff Stations (Cont.)																						
Area G: (Cont.)																						
G-SWMS-3	07/29	RO/TOT	3	UF	190	620	2.09	0.95	12.40	0.70	0.658	0.073	3.076	0.180	1.613	0.160	607.0	203.0	438.0	175.0	160	51
G-SWMS-4	05/22	RO/TOT	1	UF	880	680	0.29	1.34			0.093	0.024	0.395	0.047	2.485	0.179	20.0	4.9	29.0	4.8	28	50
G-SWMS-4	05/24	RO/TOT	1	UF					2.30	0.10												
G-SWMS-4	06/21	RO/TOT	1	UF			1.56	0.93	0.20	0.70	0.009	0.013	0.940	0.065	15.168	0.665	36.1	9.4	26.6	7.5	26	51
G-SWMS-4	07/15	RO/TOT	1	UF	580	630	0.00	7.01	–0.10	0.70	0.119	0.029	1.227	0.098	10.608	0.861	24.3	7.1	22.9	6.8	238	53
G-SWMS-5	06/17	RO/TOT	1	UF	530	630	2.68	1.45	2.10	0.70	0.084	0.024	1.236	0.093	0.235	0.040	93.4	27.0	92.3	27.1	107	51
G-SWMS-5	07/08	RO/TOT	1	UF	860	650	2.16	1.16	1.70	0.70	0.075	0.018	0.182	0.025	0.020	0.011	60.2	17.0	71.6	19.3	51	52
G-SWMS-5	09/17	RO/TOT	1	UF	1,030	680	–1.02	5.85	0.27	0.05	0.073	0.025	0.065	0.029	0.125	0.036	21.7	7.4	29.1	9.2	41	48
G-SWMS-6	05/24	RO/TOT	1	UF	250	630	1.64	0.86	1.60	0.07	0.644	0.058	6.878	0.260	0.255	0.190	45.2	9.9	46.5	6.7	110	51
G-SWMS-6	06/13	RO/TOT	1	UF	430	630	1.00	0.69	3.16	0.32	0.195	0.049	1.557	0.142	0.421	0.047	323.0	106.0	402.0	123.0	68	51
G-SWMS-6	06/13	RO/TOT	1D	UF					4.70	0.70												
G-SWMS-6	07/08	RO/TOT	1	UF			3.23	1.19	4.70	0.70	0.393	0.064	0.764	0.088	0.619	0.083	234.0	74.4	260.0	79.7	166	52
G-SWMS-6	07/20	RO/TOT	5	UF					6.60	0.90												
G-SWMS-6	07/29	RO/TOT	1	UF			2.76	1.35			0.167	0.033	0.577	0.062	0.469	0.053	462.0	171.0	409.0	169.0	216	52
G-SWMS-6	08/14	RO/D	1	F			1.43	1.00	0.17	0.02	0.017	0.011	0.025	0.013	–0.005	0.004	0.8	1.0	2.6	1.9	90	51
G-SWMS-6	08/14	RO/D	1D	F					0.03	0.05												
G-SWMS-6	08/14	RO/TOT	1	UF			–1.02	3.85	1.18	0.12	0.033	0.017	0.160	0.029	0.086	0.023	33.6	19.1	38.2	22.2	55	51
G-SWMS-6	08/14	RO/TOT	1D	UF					1.20	0.10												
G-SWMS-6	08/31	RO/D	1	F			0.00	5.52	0.24	0.02	–0.006	0.008	0.010	0.008	0.030	0.020	0.4	0.6	1.6	1.6	499	51
G-SWMS-6	08/31	RO/D	1D	F					0.26	0.08												
G-SWMS-6	08/31	RO/TOT	3	UF	420	630	0.65	1.03	5.66	0.57	0.127	0.033	0.669	0.071	0.517	0.072	9.8	3.5	10.3	3.7	623	62
G-SWMS-6	08/31	RO/TOT	3D	UF					4.30	0.40												
Detection Limits					700		4		0.1		0.04		0.04		0.04		3		3		120	
Water Quality Standards[e]																						
DOE DCG for Public Dose					2,000,000		3,000		800		40		30		30		30		1,000			
DOE Drinking Water System DCG					80,000		120		30		1.6		1.2		1.2		1.2		40			
EPA Primary Drinking Water Standard					20,000				20								15					
EPA Screening Level																			50			
NMWQCC Groundwater Limit									5,000													

[a] Except where noted. Two columns are listed: the first is the analytical result, and the second is the radioactive counting uncertainty (1 std dev). Radioactivity counting uncertainties may be less than the analytical method uncertainties.
[b] Matrix: SW–surface water; RO–runoff; D–dissolved; TOT–total.
[c] Codes: 1–primary analysis; 2–secondary analysis; R–lab replicate; D–lab duplicate.
[d] F/UF: F–filtered; UF–unfiltered.
[e] Standards given here for comparison only; see Appendix A.

Table 5-2. Strontium-90 in Surface Water and Runoff for 1999
(LANL's 1999 strontium-90 data are not valid because of analytical laboratory problems; the data appear in this report for documentary purposes only.)

Station Name	Date	Matrix[a]	Code[b]	F/UF[c]	Analyte	Value	Uncertainity	Detection Limit	Units	Detect?
Rio Chama at Chamita	06/16	SW	1	UF	^{90}Sr	0.66	0.19	0.36	pCi/L	Detect
Rio Chama at Chamita	06/16	SW	1	UF	^{90}Sr	0.70	0.18	0.34	pCi/L	Detect
Rio Grande at Embudo	10/05	SW	1	UF	^{90}Sr	–0.94	0.38	0.78	pCi/L	ND[d]
Rio Grande at Otowi Upper (bank)	08/03	SW	1	UF	^{90}Sr	1.00	0.40	0.78	pCi/L	ND
Rio Grande at Otowi (bank)	08/03	SW	1	UF	^{90}Sr	1.76	0.46	0.82	pCi/L	Detect
Rio Grande at Frijoles (bank)	09/22	SW	1	UF	^{90}Sr	0.08	0.40	0.91	pCi/L	ND
Rio Grande at Frijoles (bank)	09/22	SW	1	UF	^{90}Sr	–0.31	0.43	0.95	pCi/L	ND
Rio Grande at Cochiti	09/23	SW	1	UF	^{90}Sr	0.04	0.38	0.88	pCi/L	ND
Jemez River	08/02	SW	1	UF	^{90}Sr	–0.07	0.34	0.75	pCi/L	ND
Jemez River	08/02	SW	1	UF	^{90}Sr	0.41	0.44	0.93	pCi/L	ND
Guaje Canyon	11/16	SW	1	UF	^{90}Sr	–0.85	0.34	0.69	pCi/L	ND
Acid Weir	06/23	SW	1	UF	^{90}Sr	1.33	0.21	0.33	pCi/L	Detect
Pueblo 1	06/23	SW	1	UF	^{90}Sr	21.36	1.19	0.27	pCi/L	Detect
Pueblo 3	05/20	SW	1	UF	^{90}Sr	0.31	0.21	0.42	pCi/L	ND
Pueblo at SR–502	08/04	SW	1	UF	^{90}Sr	–0.15	0.45	1.00	pCi/L	ND
Pueblo at SR–502	12/01	SW	1	UF	^{90}Sr	–0.32	0.38	0.83	pCi/L	ND
Los Alamos Canyon Reservoir	06/23	SW	1	UF	^{90}Sr	8.66	0.57	0.31	pCi/L	Detect
Los Alamos at Upper GS	05/26	SW	1	UF	^{90}Sr	2.85	0.27	0.30	pCi/L	Detect
SCS–1	05/27	SW	1	UF	^{90}Sr	3.57	0.34	0.37	pCi/L	Detect
SCS–2	05/19	SW	1	UF	^{90}Sr	0.33	0.20	0.40	pCi/L	ND
SCS–3	06/16	SW	1	UF	^{90}Sr	0.67	0.18	0.35	pCi/L	Detect
Mortandad at GS–1	05/27	SW	1	UF	^{90}Sr	16.45	0.96	0.31	pCi/L	Detect
Mortandad at Rio Grande (A–11)	09/21	SW	1	UF	^{90}Sr	–1.46	0.89	1.92	pCi/L	ND
Pajarito at Rio Grande	09/21	SW	1	UF	^{90}Sr	–0.28	0.72	1.64	pCi/L	ND
Water Canyon at Beta	11/17	SW	1	UF	^{90}Sr	–0.01	0.29	0.65	pCi/L	ND
Ancho at Rio Grande	09/21	SW	1	UF	^{90}Sr	0.00	0.37	0.86	pCi/L	ND
Frijoles at Monument HQ	12/22	SW	1	UF	^{90}Sr	–0.94	0.42	0.87	pCi/L	ND
Frijoles at Rio Grande	12/22	SW	1	UF	^{90}Sr	–0.25	0.36	0.81	pCi/L	ND
LA Canyon near LA	04/30	RO/D	1	F	^{90}Sr	5.47	0.42	0.32	pCi/L	Detect
LA Canyon near LA	05/03	RO/D	1	F	^{90}Sr	3.31	0.30	0.31	pCi/L	Detect
LA Canyon near LA	07/08	RO/D	1	F	^{90}Sr	5.15	0.41	0.35	pCi/L	Detect
LA Canyon near LA	08/09	RO/D	1	F	^{90}Sr	2.31	0.31	0.42	pCi/L	Detect
LA Canyon near LA	08/10	RO/D	1	F	^{90}Sr	3.22	0.81	1.47	pCi/L	Detect
LA Canyon near LA	04/30	RO/TOT	1	UF	^{90}Sr	32.06	1.74	0.30	pCi/L	Detect
LA Canyon near LA	05/03	RO/TOT	1	UF	^{90}Sr	4.28	0.37	0.35	pCi/L	Detect
LA Canyon near LA	07/08	RO/TOT	1	UF	^{90}Sr	32.91	1.75	0.26	pCi/L	Detect

Table 5-2. Strontium-90 in Surface Water and Runoff for 1999 (Cont.)
(LANL's 1999 strontium-90 data are not valid because of analytical laboratory problems; the data appear in this report for documentary purposes only.)

Station Name	Date	Matrix[a]	Code[b]	F/UF[c]	Analyte	Value	Uncertainity	Detection Limit	Units	Detect?
LA Canyon near LA	08/09	RO/TOT	1	UF	^{90}Sr	29.80	1.67	0.39	pCi/L	Detect
LA Canyon near LA	08/10	RO/TOT	1	UF	^{90}Sr	36.76	2.29	0.84	pCi/L	Detect
DP Canyon near Los Alamos	06/23	RO/D	1	F	^{90}Sr	10.05	0.66	0.35	pCi/L	Detect
DP Canyon near Los Alamos	06/23	RO/TOT	1	UF	^{90}Sr	32.25	1.73	0.29	pCi/L	Detect
DP Canyon near Los Alamos	08/14	RO/TOT	1	UF	^{90}Sr	14.17	1.11	0.82	pCi/L	Detect
Sandia Canyon below Power Plant	05/28	RO/TOT	1	UF	^{90}Sr	6.95	0.47	0.26	pCi/L	Detect
Sandia Canyon below Wetlands	07/12	RO/TOT	1	UF	^{90}Sr	3.94	0.34	0.32	pCi/L	Detect
Sandia Canyon below Wetlands	08/10	RO/TOT	1	UF	^{90}Sr	2.10	0.83	1.64	pCi/L	ND
Sandia Canyon near Roads & Grounds at TA–3	05/28	RO/TOT	1	UF	^{90}Sr	5.56	0.39	0.25	pCi/L	Detect
Sandia Canyon near Roads & Grounds at TA–3	07/14	RO/TOT	1	UF	^{90}Sr	1.57	0.22	0.32	pCi/L	Detect
Sandia Canyon near Roads & Grounds at TA–3	08/10	RO/TOT	1	UF	^{90}Sr	4.33	0.81	1.33	pCi/L	Detect
Cañada del Buey at WR	06/17	RO/D	1	F	^{90}Sr	0.30	0.15	0.29	pCi/L	ND
Cañada del Buey at WR	06/17	RO/TOT	1	UF	^{90}Sr	58.82	3.05	0.29	pCi/L	Detect
Cañada del Buey at WR	08/06	RO/TOT	1	UF	^{90}Sr	36.37	2.22	0.74	pCi/L	Detect
Cañada del Buey at WR	08/23	RO/TOT	1	UF	^{90}Sr	55.07	3.18	0.75	pCi/L	Detect
Pajarito Canyon above SR–4	06/17	RO/D	1	F	^{90}Sr	0.46	0.14	0.27	pCi/L	Detect
Pajarito Canyon above SR–4	06/17	RO/TOT	1	UF	^{90}Sr	10.26	0.64	0.27	pCi/L	Detect
Potrillo Canyon near WR	08/31	RO/D	1	F	^{90}Sr	0.74	0.56	1.15	pCi/L	ND
Potrillo Canyon near WR	08/31	RO/TOT	1	UF	^{90}Sr	14.17	0.96	0.49	pCi/L	Detect
Ancho Canyon at TA–39	07/27	RO/TOT	1	UF	^{90}Sr	0.46	0.17	0.34	pCi/L	ND
Ancho Canyon at TA–39	08/04	RO/TOT	1	UF	^{90}Sr	73.77	4.58	1.63	pCi/L	Detect
Ancho Canyon at TA–39	08/10	RO/TOT	1	UF	^{90}Sr	63.58	4.00	1.55	pCi/L	Detect
Ancho Canyon near Bandelier	07/08	RO/D	1	F	^{90}Sr	0.79	0.24	0.44	pCi/L	Detect
Ancho Canyon near Bandelier	06/18	RO/TOT	1	UF	^{90}Sr	60.95	3.27	0.54	pCi/L	Detect
Ancho Canyon near Bandelier	07/08	RO/TOT	1	UF	^{90}Sr	19.98	1.19	0.42	pCi/L	Detect
TA–55	08/14	RO/D	1	F	^{90}Sr	0.30	0.35	0.76	pCi/L	ND
TA–55	08/14	RO/TOT	1	UF	^{90}Sr	–0.08	0.32	0.72	pCi/L	ND
Area L	08/14	RO/TOT	1	UF	^{90}Sr	–0.31	0.46	1.03	pCi/L	ND

Table 5-2. Strontium-90 in Surface Water and Runoff for 1999 (Cont.)
(LANL's 1999 strontium-90 data are not valid because of analytical laboratory problems; the data appear in this report for documentary purposes only.)

Station Name	Date	Matrix[a]	Code[b]	F/UF[c]	Analyte	Value	Uncertainity	Detection Limit	Units	Detect?
G–SWMS–1	07/29	RO/D	1	F	^{90}Sr	–0.05	0.16	0.36	pCi/L	ND
G–SWMS–1	07/29	RO/TOT	1	UF	^{90}Sr	21.67	1.24	0.34	pCi/L	Detect
G–SWMS–2	05/24	RO/TOT	1	UF	^{90}Sr	33.82	1.82	0.30	pCi/L	Detect
G–SWMS–2	07/08	RO/TOT	1	UF	^{90}Sr	11.91	0.71	0.27	pCi/L	Detect
G–SWMS–2	07/29	RO/TOT	1	UF	^{90}Sr	12.11	0.95	0.68	pCi/L	Detect
G–SWMS–3	07/29	RO/D	1	F	^{90}Sr	0.69	0.18	0.33	pCi/L	Detect
G–SWMS–3	05/28	RO/TOT	1	UF	^{90}Sr	101.40	5.15	0.33	pCi/L	Detect
G–SWMS–3	06/17	RO/TOT	1	UF	^{90}Sr	76.50	4.00	0.46	pCi/L	Detect
G–SWMS–3	07/15	RO/TOT	1	UF	^{90}Sr	43.97	2.58	0.86	pCi/L	Detect
G–SWMS–3	07/29	RO/TOT	1	UF	^{90}Sr	10.82	0.71	0.37	pCi/L	Detect
G–SWMS–4	05/22	RO/TOT	1	UF	^{90}Sr	7.74	0.53	0.30	pCi/L	Detect
G–SWMS–4	06/21	RO/TOT	1	UF	^{90}Sr	2.08	0.25	0.34	pCi/L	Detect
G–SWMS–4	07/15	RO/TOT	1	UF	^{90}Sr	2.26	0.26	0.34	pCi/L	Detect
G–SWMS–5	06/17	RO/TOT	1	UF	^{90}Sr	28.48	1.53	0.26	pCi/L	Detect
G–SWMS–5	07/08	RO/TOT	1	UF	^{90}Sr	6.39	0.45	0.29	pCi/L	Detect
G–SWMS–6	08/14	RO/D	1	F	^{90}Sr	0.29	0.42	0.94	pCi/L	ND
G–SWMS–6	08/31	RO/D	1	F	^{90}Sr	0.55	0.36	0.73	pCi/L	ND
G–SWMS–6	05/24	RO/TOT	1	UF	^{90}Sr	13.91	0.83	0.30	pCi/L	Detect
G–SWMS–6	06/13	RO/TOT	1	UF	^{90}Sr	15.15	0.87	0.25	pCi/L	Detect
G–SWMS–6	07/08	RO/TOT	1	UF	^{90}Sr	16.33	0.94	0.27	pCi/L	Detect
G–SWMS–6	07/29	RO/TOT	1	UF	^{90}Sr	20.00	1.14	0.31	pCi/L	Detect
G–SWMS–6	08/14	RO/TOT	1	UF	^{90}Sr	5.59	0.65	0.81	pCi/L	Detect
G–SWMS–6	08/31	RO/TOT	1	UF	^{90}Sr	14.49	1.01	0.55	pCi/L	Detect

[a] Matrix: SW–surface water; RO–runoff; D–dissolved; TOT–total.
[b] Codes: 1–primary analysis; 2–secondary analysis; R–lab replicate; D–lab duplicate.
[c] F/UF: F–filtered; UF–unfiltered.
[d] ND = not detected.

Table 5-3. Detections of Radionuclides[a] and Comparison to Department of Energy Derived Concentration Guides[b] in Surface Water and Runoff Samples for 1999

Station Name	Date	Code[c]	F/UF[d]	Matrix[e]	Analyte	Value	Uncertainty[f]	Detection Limit	Units	DOE DCG	Ratio of Value to DCG	Ratio of Value to Minimum Standard	Minimum Standard	Minimum Standard Type
Ancho Canyon at TA-39	08/04	1	UF	RO/TOT	^{241}Am	0.314	0.076	0.151	pCi/L					
Ancho Canyon at TA-39	08/10	1	UF	RO/TOT	^{241}Am	0.167	0.030	0.039	pCi/L					
Ancho Canyon at TA-39	08/04	1	UF	RO/TOT	Beta	1,010.0	297.0		pCi/L	1,000	1.01	20.20	50	EPA Screening Level
Ancho Canyon at TA-39	07/27	1	UF	RO/TOT	^{137}Cs	6.51	1.64	3.22	pCi/L					
Ancho Canyon at TA-39	08/04	1	UF	RO/TOT	^{137}Cs	5.57	1.83	4.13	pCi/L					
Ancho Canyon at TA-39	08/10	1	UF	RO/TOT	^{137}Cs	5.77	1.61	3.77	pCi/L					
Ancho Canyon at TA-39	08/04	1	UF	RO/TOT	Gamma	207	52	80	pCi/L					
Ancho Canyon at TA-39	08/10	1	UF	RO/TOT	^{238}Pu	0.238	0.046	0.076	pCi/L					
Ancho Canyon at TA-39	07/27	1	UF	RO/TOT	^{239,240}Pu	0.207	0.040	0.068	pCi/L					
Ancho Canyon at TA-39	08/04	1	UF	RO/TOT	^{239,240}Pu	0.314	0.061	0.103	pCi/L					
Ancho Canyon at TA-39	08/10	1	UF	RO/TOT	^{239,240}Pu	0.774	0.084	0.066	pCi/L					
Ancho Canyon at TA-39	08/04	1	UF	RO/TOT	U	14.00	1.00		µg/L					
Ancho Canyon at TA-39	08/04	1	UF	RO/TOT	U	6.30	0.63		µg/L					
Ancho Canyon at TA-39	08/10	1	UF	RO/TOT	U	12.60	0.40		µg/L					
Ancho Canyon at TA-39	08/10	1	UF	RO/TOT	U	5.16	0.52		µg/L					
Ancho Canyon near Bandelier	06/18	1	UF	RO/TOT	^{241}Am	0.399	0.058	0.079	pCi/L					
Ancho Canyon near Bandelier	07/27	1	UF	RO/TOT	^{241}Am	0.000	0.000	0.000	pCi/L					
Ancho Canyon near Bandelier	06/18	1	UF	RO/TOT	Beta	829.0	251.0		pCi/L	1,000	0.83	16.58	50	EPA Screening Level
Ancho Canyon near Bandelier	06/18	1	UF	RO/TOT	^{137}Cs	5.59	1.03	2.42	pCi/L					
Ancho Canyon near Bandelier	07/08	1	UF	RO/TOT	^{137}Cs	2.80	0.92	2.80	pCi/L					
Ancho Canyon near Bandelier	07/27	1	UF	RO/TOT	^{137}Cs	12.49	2.27	5.34	pCi/L					
Ancho Canyon near Bandelier	06/18	1	UF	RO/TOT	Gamma	162	52	80	pCi/L					
Ancho Canyon near Bandelier	07/27	1	UF	RO/TOT	Gamma	315	52	80	pCi/L					
Ancho Canyon near Bandelier	07/27	1	UF	RO/TOT	^{238}Pu	0.000	0.000	0.000	pCi/L					
Ancho Canyon near Bandelier	06/18	1	UF	RO/TOT	^{239,240}Pu	0.775	0.102	0.097	pCi/L					
Ancho Canyon near Bandelier	07/08	1	UF	RO/TOT	^{239,240}Pu	0.285	0.063	0.109	pCi/L					
Ancho Canyon near Bandelier	07/27	1	UF	RO/TOT	^{239,240}Pu	0.000	0.000	0.000	pCi/L					
Ancho Canyon near Bandelier	06/18	1	UF	RO/TOT	U	170.00	20.00		µg/L	800	0.21	8.50	20	Proposed EPA Primary Drinking Water Standard
Ancho Canyon near Bandelier	07/08	1	UF	RO/TOT	U	12.00	1.00		µg/L					
Ancho Canyon near Bandelier	08/03	1	UF	RO/TOT	U	5.30	0.50		µg/L					
Ancho Canyon near Bandelier	08/04	1	UF	RO/TOT	U	9.00	1.00		µg/L					
Area L	08/14	1	UF	RO/TOT	^{137}Cs	3.67	0.90	2.42	pCi/L					
Cañada del Buey at WR	06/17	1	UF	RO/TOT	Alpha	208.0	55.6		pCi/L	30	6.93	13.87	15	EPA Primary Drinking Water Standard
Cañada del Buey at WR	06/17	1	F	RO/D	^{241}Am	0.074	0.019	0.041	pCi/L					
Cañada del Buey at WR	06/17	1	UF	RO/TOT	^{241}Am	0.488	0.062	0.051	pCi/L					

Table 5-3. Detections of Radionuclides[a] and Comparison to Department of Energy Derived Concentration Guides[b] in Surface Water and Runoff Samples for 1999 (Cont.)

Station Name	Date	Code[c]	F/UF[d]	Matrix[e]	Analyte	Value	Uncertainty[f]	Detection Limit	Units	DOE DCG	Ratio of Value to DCG	Ratio of Value to Minimum Standard	Minimum Standard	Minimum Standard Type
Cañada del Buey at WR	08/06	1	UF	RO/TOT	^{241}Am	0.137	0.033	0.081	pCi/L					
Cañada del Buey at WR	08/23	1	UF	RO/TOT	^{241}Am	0.319	0.049	0.040	pCi/L					
Cañada del Buey at WR	09/16	1	UF	RO/TOT	^{241}Am	0.235	0.039	0.059	pCi/L					
Cañada del Buey at WR	06/17	1	UF	RO/TOT	Beta	160.0	46.5		pCi/L	1,000	0.16	3.20	50	EPA Screening Level
Cañada del Buey at WR	08/23	1	UF	RO/TOT	^{137}Cs	3.67	0.90	2.42	pCi/L					
Cañada del Buey at WR	08/06	1	UF	RO/TOT	Gamma	201	52	80	pCi/L					
Cañada del Buey at WR	08/23	1	UF	RO/TOT	Gamma	179	51	80	pCi/L					
Cañada del Buey at WR	09/16	1	UF	RO/TOT	Gamma	230	50	80	pCi/L					
Cañada del Buey at WR	06/17	1	UF	RO/TOT	^{238}Pu	0.578	0.054	0.052	pCi/L					
Cañada del Buey at WR	08/06	1	UF	RO/TOT	^{238}Pu	0.119	0.038	0.073	pCi/L					
Cañada del Buey at WR	08/23	1	UF	RO/TOT	^{238}Pu	0.136	0.037	0.046	pCi/L					
Cañada del Buey at WR	09/16	1	UF	RO/TOT	^{238}Pu	0.161	0.037	0.069	pCi/L					
Cañada del Buey at WR	06/17	1	UF	RO/TOT	^{239,240}Pu	2.044	0.110	0.047	pCi/L	30	0.07	1.70	1.2	DOE Drinking Water DCG
Cañada del Buey at WR	08/06	1	UF	RO/TOT	^{239,240}Pu	0.147	0.043	0.073	pCi/L					
Cañada del Buey at WR	08/23	1	UF	RO/TOT	^{239,240}Pu	0.288	0.055	0.113	pCi/L					
Cañada del Buey at WR	09/16	1	UF	RO/TOT	^{239,240}Pu	1.305	0.107	0.092	pCi/L	30	0.04	1.09	1.2	DOE Drinking Water DCG
Cañada del Buey at WR	06/17	1	UF	RO/TOT	U	6.47	0.65		µg/L					
Cañada del Buey at WR	08/06	1	UF	RO/TOT	U	11.50	0.50		µg/L					
Cañada del Buey at WR	08/06	1	UF	RO/TOT	U	5.43	0.54		µg/L					
Cañada del Buey at WR	08/23	1	UF	RO/TOT	U	14.00	1.00		µg/L					
Cañada del Buey at WR	08/23	1	UF	RO/TOT	U	7.41	0.74		µg/L					
DP Canyon near Los Alamos	06/23	1	UF	RO/TOT	Alpha	165.0	49.9		pCi/L	30	5.50	11.00	15	EPA Primary Drinking Water Standard
DP Canyon near Los Alamos	06/23	1	F	RO/D	^{241}Am	0.043	0.011	0.024	pCi/L					
DP Canyon near Los Alamos	06/23	1	UF	RO/TOT	^{241}Am	7.362	0.336	0.112	pCi/L	30	0.25	6.14	1.2	DOE Drinking Water DCG
DP Canyon near Los Alamos	08/14	1	UF	RO/TOT	^{241}Am	2.576	0.180	0.065	pCi/L	30	0.09	2.15	1.2	DOE Drinking Water DCG
DP Canyon near Los Alamos	09/16	1	UF	RO/TOT	^{241}Am	4.443	0.201	0.053	pCi/L	30	0.15	3.70	1.2	DOE Drinking Water DCG
DP Canyon near Los Alamos	06/23	1	UF	RO/TOT	Beta	282.0	73.3		pCi/L	1,000	0.28	5.64	50	EPA Screening Level
DP Canyon near Los Alamos	09/16	1	UF	RO/TOT	Beta	324.0	93.5		pCi/L	1,000	0.32	6.48	50	EPA Screening Level
DP Canyon near Los Alamos	06/23	1	UF	RO/TOT	^{137}Cs	22.01	2.87	2.64	pCi/L					
DP Canyon near Los Alamos	08/14	1	UF	RO/TOT	^{137}Cs	5.36	1.39	3.01	pCi/L					
DP Canyon near Los Alamos	09/16	1	UF	RO/TOT	^{137}Cs	16.17	2.26	2.67	pCi/L					
DP Canyon near Los Alamos	09/16	1	UF	RO/TOT	Gamma	221	49	80	pCi/L					

Table 5-3. Detections of Radionuclides[a] and Comparison to Department of Energy Derived Concentration Guides[b] in Surface Water and Runoff Samples for 1999 (Cont.)

Station Name	Date	Code[c]	F/UF[d]	Matrix[e]	Analyte	Value	Uncertainty[f]	Detection Limit	Units	DOE DCG	Ratio of Value to DCG	Ratio of Value to Minimum Standard	Minimum Standard	Minimum Standard Type
DP Canyon near Los Alamos	06/23	1	UF	RO/TOT	^{238}Pu	0.645	0.085	0.061	pCi/L					
DP Canyon near Los Alamos	08/14	1	UF	RO/TOT	^{238}Pu	0.062	0.019	0.032	pCi/L					
DP Canyon near Los Alamos	06/23	1	UF	RO/TOT	^{239,240}Pu	2.928	0.201	0.089	pCi/L	30	0.10	2.44	1.2	DOE Drinking Water DCG
DP Canyon near Los Alamos	08/14	1	UF	RO/TOT	^{239,240}Pu	0.962	0.076	0.057	pCi/L					
DP Canyon near Los Alamos	09/16	1	UF	RO/TOT	^{239,240}Pu	1.835	0.126	0.041	pCi/L	30	0.06	1.53	1.2	DOE Drinking Water DCG
G-SWMS-1	07/29	1	UF	RO/TOT	Beta	421.0	129.0		pCi/L	1,000	0.42	8.42	50	EPA Screening Level
G-SWMS-1	07/29	1	UF	RO/TOT	Gamma	180	51	80	pCi/L					
G-SWMS-1	07/29	1	UF	RO/TOT	^{238}Pu	1.016	0.072	0.044	pCi/L					
G-SWMS-1	07/29	1	F	RO/D	^{239,240}Pu	0.039	0.012	0.019	pCi/L					
G-SWMS-1	07/29	1	UF	RO/TOT	^{239,240}Pu	0.410	0.044	0.039	pCi/L					
G-SWMS-1	07/29	1	UF	RO/TOT	U	5.00	0.60		µg/L					
G-SWMS-1	07/29	1	UF	RO/TOT	U	5.52	0.55		µg/L					
G-SWMS-2	05/24	1	UF	RO/TOT	Alpha	256.0	51.4		pCi/L	30	8.53	17.07	15	EPA Primary Drinking Water Standard
G-SWMS-2	07/08	1	UF	RO/TOT	Alpha	161.0	46.2		pCi/L	30	5.37	10.73	15	EPA Primary Drinking Water Standard
G-SWMS-2	07/29	1	UF	RO/TOT	Alpha	128.0	41.0		pCi/L	30	4.27	8.53	15	EPA Primary Drinking Water Standard
G-SWMS-2	05/24	1	UF	RO/TOT	^{241}Am	0.220	0.046	0.107	pCi/L					
G-SWMS-2	07/08	1	UF	RO/TOT	^{241}Am	0.060	0.012	0.020	pCi/L					
G-SWMS-2	07/29	1	UF	RO/TOT	^{241}Am	0.721	0.216	0.038	pCi/L					
G-SWMS-2	05/24	1	UF	RO/TOT	Beta	195.0	22.6		pCi/L	1,000	0.20	3.90	50	EPA Screening Level
G-SWMS-2	07/08	1	UF	RO/TOT	Beta	194.0	52.9		pCi/L	1,000	0.19	3.88	50	EPA Screening Level
G-SWMS-2	05/24	1	UF	RO/TOT	^{137}Cs	1.54	0.35	0.97	pCi/L					
G-SWMS-2	07/29	1	UF	RO/TOT	^{137}Cs	26.64	4.29	6.36	pCi/L					
G-SWMS-2	07/29	1	UF	RO/TOT	Gamma	199	52	80	pCi/L					
G-SWMS-2	05/24	1	UF	RO/TOT	^{238}Pu	0.107	0.027	0.045	pCi/L					
G-SWMS-2	07/29	1	UF	RO/TOT	^{238}Pu	0.088	0.021	0.034	pCi/L					
G-SWMS-2	05/24	1	UF	RO/TOT	^{239,240}Pu	1.284	0.096	0.041	pCi/L	30	0.04	1.07	1.2	DOE Drinking Water DCG
G-SWMS-2	07/08	1	UF	RO/TOT	^{239,240}Pu	0.270	0.044	0.045	pCi/L					
G-SWMS-2	07/29	1	UF	RO/TOT	^{239,240}Pu	0.302	0.038	0.024	pCi/L					
G-SWMS-3	05/28	1	UF	RO/TOT	Alpha	72.1	15.1		pCi/L	30	2.40	4.81	15	EPA Primary Drinking Water Standard
G-SWMS-3	06/17	1	UF	RO/TOT	Alpha	278.0	83.5		pCi/L	30	9.27	18.53	15	EPA Primary Drinking Water Standard

Table 5-3. Detections of Radionuclides[a] and Comparison to Department of Energy Derived Concentration Guides[b] in Surface Water and Runoff Samples for 1999 (Cont.)

Station Name	Date	Code[c]	F/UF[d]	Matrix[e]	Analyte	Value	Uncertainty[f]	Detection Limit	Units	DOE DCG	Ratio of Value to DCG	Ratio of Value to Minimum Standard	Minimum Standard	Minimum Standard Type
G-SWMS-3	07/15	1	UF	RO/TOT	Alpha	429.0	128.0		pCi/L	30	14.30	28.60	.5	EPA Primary Drinking Water Standard
G-SWMS-3	05/28	1	UF	RO/TOT	^{241}Am	1.001	0.085	0.046	pCi/L					
G-SWMS-3	06/17	1	UF	RO/TOT	^{241}Am	0.391	0.041	0.038	pCi/L					
G-SWMS-3	07/15	1	UF	RO/TOT	^{241}Am	1.060	0.113	0.132	pCi/L					
G-SWMS-3	07/29	1	UF	RO/TOT	^{241}Am	1.613	0.160	0.094	pCi/L	30	0.05	1.34	1.2	DOE Drinking Water DCG
G-SWMS-3	05/28	1	UF	RO/TOT	Beta	59.7	7.6		pCi/L	1,000	0.06	1.19	50	EPA Screening Level
G-SWMS-3	06/17	1	UF	RO/TOT	Beta	383.0	105.0		pCi/L	1,000	0.38	7.66	50	EPA Screening Level
G-SWMS-3	07/15	1	UF	RO/TOT	Beta	504.0	143.0		pCi/L	1,000	0.50	10.08	50	EPA Screening Level
G-SWMS-3	05/28	1	UF	RO/TOT	Gamma	199	52	80	pCi/L					
G-SWMS-3	06/17	1	UF	RO/TOT	Gamma	222	53	80	pCi/L					
G-SWMS-3	07/15	1	UF	RO/TOT	Gamma	191	53	80	pCi/L					
G-SWMS-3	07/29	1	UF	RO/TOT	Gamma	160	51	80	pCi/L					
G-SWMS-3	05/28	1	UF	RO/TOT	^{238}Pu	0.370	0.047	0.060	pCi/L					
G-SWMS-3	06/17	1	UF	RO/TOT	^{238}Pu	0.427	0.070	0.120	pCi/L					
G-SWMS-3	07/15	1	UF	RO/TOT	^{238}Pu	0.976	0.124	0.094	pCi/L					
G-SWMS-3	07/29	1	UF	RO/TOT	^{238}Pu	0.658	0.073	0.049	pCi/L					
G-SWMS-3	05/28	1	UF	RO/TOT	^{239,240}Pu	1.930	0.116	0.037	pCi/L	30	0.06	1.61	1.2	DOE Drinking Water DCG
G-SWMS-3	06/17	1	UF	RO/TOT	^{239,240}Pu	2.155	0.157	0.135	pCi/L	30	0.07	1.80	1.2	DOE Drinking Water DCG
G-SWMS-3	07/15	1	UF	RO/TOT	^{239,240}Pu	3.064	0.243	0.076	pCi/L	30	0.10	2.55	1.2	DOE Drinking Water DCG
G-SWMS-3	07/29	1	UF	RO/TOT	^{239,240}Pu	3.076	0.180	0.091	pCi/L	30	0.10	2.56	1.2	DOE Drinking Water DCG
G-SWMS-3	05/28	1	UF	RO/TOT	U	9.00	1.00		µg/L					
G-SWMS-3	07/15	1	UF	RO/TOT	U	9.00	1.00		µg/L					
G-SWMS-3	07/29	1	UF	RO/TOT	U	12.40	0.70		µg/L					
G-SWMS-4	05/22	1	UF	RO/TOT	Alpha	20.0	4.9		pCi/L	30	0.67	1.33	15	EPA Primary Drinking Water Standard
G-SWMS-4	06/21	1	UF	RO/TOT	Alpha	36.1	9.4		pCi/L	30	1.20	2.41	15	EPA Primary Drinking Water Standard
G-SWMS-4	07/15	1	UF	RO/TOT	Alpha	24.3	7.1		pCi/L	30	0.81	1.62	15	EPA Primary Drinking Water Standard
G-SWMS-4	05/22	1	UF	RO/TOT	^{241}Am	2.485	0.179	0.067	pCi/L	30	0.08	2.07	1.2	DOE Drinking Water DCG

Table 5-3. Detections of Radionuclides[a] and Comparison to Department of Energy Derived Concentration Guides[b] in Surface Water and Runoff Samples for 1999 (Cont.)

Station Name	Date	Code[c]	F/UF[d]	Matrix[e]	Analyte	Value	Uncertainty[f]	Detection Limit	Units	DOE DCG	Ratio of Value to DCG	Ratio of Value to Minimum Standard	Minimum Standard	Minimum Standard Type
G-SWMS-4	06/21	1	UF	RO/TOT	^{241}Am	15.168	0.665	0.073	pCi/L	30	0.51	12.64	1.2	DOE Drinking Water DCG
G-SWMS-4	07/15	1	UF	RO/TOT	^{241}Am	10.608	0.861	0.089	pCi/L	30	0.35	8.84	1.2	DOE Drinking Water DCG
G-SWMS-4	05/22	1	UF	RO/TOT	Beta	29.0	4.8		pCi/L					
G-SWMS-4	06/21	1	UF	RO/TOT	Beta	26.6	7.5		pCi/L					
G-SWMS-4	07/15	1	UF	RO/TOT	Beta	22.9	6.8		pCi/L					
G-SWMS-4	07/15	1	UF	RO/TOT	Gamma	238	53	80	pCi/L					
G-SWMS-4	05/22	1	UF	RO/TOT	^{238}Pu	0.093	0.024	0.046	pCi/L					
G-SWMS-4	07/15	1	UF	RO/TOT	^{238}Pu	0.119	0.029	0.045	pCi/L					
G-SWMS-4	05/22	1	UF	RO/TOT	^{239,240}Pu	0.395	0.047	0.035	pCi/L					
G-SWMS-4	06/21	1	UF	RO/TOT	^{239,240}Pu	0.940	0.065	0.034	pCi/L					
G-SWMS-4	07/15	1	UF	RO/TOT	^{239,240}Pu	1.227	0.098	0.036	pCi/L	30	0.04	1.02	1.2	DOE Drinking Water DCG
G-SWMS-5	06/17	1	UF	RO/TOT	Alpha	93.4	27.0		pCi/L	30	3.11	6.23	15	EPA Primary Drinking Water Standard
G-SWMS-5	07/08	1	UF	RO/TOT	Alpha	60.2	17.0		pCi/L	30	2.01	4.01	15	EPA Primary Drinking Water Standard
G-SWMS-5	06/17	1	UF	RO/TOT	^{241}Am	0.235	0.040	0.046	pCi/L					
G-SWMS-5	09/17	1	UF	RO/TOT	^{241}Am	0.125	0.036	0.084	pCi/L					
G-SWMS-5	06/17	1	UF	RO/TOT	Beta	92.3	27.1		pCi/L	1,000	0.09	1.85	50	EPA Screening Level
G-SWMS-5	07/08	1	UF	RO/TOT	Beta	71.6	19.3		pCi/L	1,000	0.07	1.43	50	EPA Screening Level
G-SWMS-5	09/17	1	UF	RO/TOT	Beta	29.1	9.2		pCi/L					
G-SWMS-5	06/17	1	UF	RO/TOT	^{238}Pu	0.084	0.024	0.041	pCi/L					
G-SWMS-5	07/08	1	UF	RO/TOT	^{238}Pu	0.075	0.018	0.044	pCi/L					
G-SWMS-5	06/17	1	UF	RO/TOT	^{239,240}Pu	1.236	0.093	0.048	pCi/L	30	0.04	1.03	1.2	DOE Drinking Water DCG
G-SWMS-5	07/08	1	UF	RO/TOT	^{239,240}Pu	0.182	0.025	0.021	pCi/L					
G-SWMS-6	05/24	1	UF	RO/TOT	Alpha	45.2	9.9		pCi/L	30	1.51	3.01	15	EPA Primary Drinking Water Standard
G-SWMS-6	06/13	1	UF	RO/TOT	Alpha	323.0	106.0		pCi/L	30	10.77	21.53	15	EPA Primary Drinking Water Standard
G-SWMS-6	07/08	1	UF	RO/TOT	Alpha	234.0	74.4		pCi/L	30	7.80	15.60	15	EPA Primary Drinking Water Standard
G-SWMS-6	06/13	1	UF	RO/TOT	^{241}Am	0.421	0.047	0.067	pCi/L					
G-SWMS-6	07/08	1	UF	RO/TOT	^{241}Am	0.619	0.083	0.084	pCi/L					
G-SWMS-6	07/29	1	UF	RO/TOT	^{241}Am	0.469	0.053	0.070	pCi/L					

Table 5-3. Detections of Radionuclides[a] and Comparison to Department of Energy Derived Concentration Guides[b] in Surface Water and Runoff Samples for 1999 (Cont.)

Station Name	Date	Code[c]	F/UF[d]	Matrix[e]	Analyte	Value	Uncertainty[f]	Detection Limit	Units	DOE DCG	Ratio of Value to DCG	Ratio of Value to Minimum Standard	Minimum Standard	Minimum Standard Type
G-SWMS-6	08/14	1	UF	RO/TOT	^{241}Am	0.086	0.023	0.038	pCi/L					
G-SWMS-6	08/31	1	UF	RO/TOT	^{241}Am	0.517	0.072	0.053	pCi/L					
G-SWMS-6	05/24	1	UF	RO/TOT	Beta	46.5	6.7		pCi/L					
G-SWMS-6	06/13	1	UF	RO/TOT	Beta	402.0	123.0		pCi/L	1,000	0.40	8.04	50	EPA Screening Level
G-SWMS-6	07/08	1	UF	RO/TOT	Beta	260.0	79.7		pCi/L	1,000	0.26	5.20	50	EPA Screening Level
G-SWMS-6	08/31	1	F	RO/D	Gamma	499	51	80	pCi/L					
G-SWMS-6	07/08	1	UF	RO/TOT	Gamma	166	52	80	pCi/L					
G-SWMS-6	07/29	1	UF	RO/TOT	Gamma	216	52	80	pCi/L					
G-SWMS-6	08/31	1	UF	RO/TOT	Gamma	623	62	80	pCi/L					
G-SWMS-6	05/24	1	UF	RO/TOT	^{238}Pu	0.644	0.058	0.060	pCi/L					
G-SWMS-6	06/13	1	UF	RO/TOT	^{238}Pu	0.195	0.049	0.076	pCi/L					
G-SWMS-6	07/08	1	UF	RO/TOT	^{238}Pu	0.393	0.064	0.097	pCi/L					
G-SWMS-6	07/29	1	UF	RO/TOT	^{238}Pu	0.167	0.033	0.034	pCi/L					
G-SWMS-6	08/31	1	UF	RO/TOT	^{238}Pu	0.127	0.033	0.054	pCi/L					
G-SWMS-6	05/24	1	UF	RO/TOT	^{239,240}Pu	6.878	0.260	0.014	pCi/L	30	0.23	5.73	1.2	DOE Drinking Water DCG
G-SWMS-6	06/13	1	UF	RO/TOT	^{239,240}Pu	1.557	0.142	0.067	pCi/L	30	0.05	1.30	1.2	DOE Drinking Water DCG
G-SWMS-6	07/08	1	UF	RO/TOT	^{239,240}Pu	0.764	0.088	0.062	pCi/L					
G-SWMS-6	07/29	1	UF	RO/TOT	^{239,240}Pu	0.577	0.062	0.044	pCi/L					
G-SWMS-6	08/14	1	UF	RO/TOT	^{239,240}Pu	0.160	0.029	0.034	pCi/L					
G-SWMS-6	08/31	1	UF	RO/TOT	^{239,240}Pu	0.669	0.071	0.033	pCi/L					
G-SWMS-6	07/20	1	UF	RO/TOT	U	6.60	0.90		µg/L					
G-SWMS-6	08/31	1	UF	RO/TOT	U	5.66	0.57		µg/L					
LA Canyon below TA-2	09/16	1	UF	RO/TOT	^{241}Am	0.220	0.037	0.063	pCi/L					
LA Canyon below TA-2	09/16	1	UF	RO/TOT	^{238}Pu	0.173	0.036	0.038	pCi/L					
LA Canyon below TA-2	09/16	1	UF	RO/TOT	^{239,240}Pu	6.298	0.289	0.055	pCi/L	30	0.21	5.25	1.2	DOE Drinking Water DCG
LA Canyon near LA	04/30	1	UF	RO/TOT	Alpha	81.8	17.1		pCi/L	30	2.73	5.45	15	EPA Primary Drinking Water Standard
LA Canyon near LA	05/03	1	UF	RO/TOT	Alpha	18.1	4.3		pCi/L	30	0.60	1.21	15	EPA Primary Drinking Water Standard
LA Canyon near LA	07/08	1	UF	RO/TOT	Alpha	160.0	48.7		pCi/L	30	5.33	10.67	15	EPA Primary Drinking Water Standard
LA Canyon near LA	04/30	1	F	RO/D	^{241}Am	0.083	0.026	0.073	pCi/L					
LA Canyon near LA	08/10	1	F	RO/D	^{241}Am	0.069	0.019	0.053	pCi/L					
LA Canyon near LA	04/30	1	UF	RO/TOT	^{241}Am	9.466	0.411	0.045	pCi/L	30	0.32	7.89	1.2	DOE Drinking Water DCG

Table 5-3. Detections of Radionuclides[a] and Comparison to Department of Energy Derived Concentration Guides[b] in Surface Water and Runoff Samples for 1999 (Cont.)

Station Name	Date	Code[c]	F/UF[d]	Matrix[e]	Analyte	Value	Uncertainty[f]	Detection Limit	Units	DOE DCG	Ratio of Value to DCG	Ratio of Value to Minimum Standard	Minimum Standard	Minimum Standard Type
LA Canyon near LA	05/03	1	UF	RO/TOT	^{241}Am	0.939	0.086	0.057	pCi/L					
LA Canyon near LA	07/08	1	UF	RO/TOT	^{241}Am	7.393	0.240	0.018	pCi/L	30	0.25	6.16	1.2	DOE Drinking Water DCG
LA Canyon near LA	08/09	1	UF	RO/TOT	^{241}Am	2.921	0.187	0.099	pCi/L	30	0.10	2.43	1.2	DOE Drinking Water DCG
LA Canyon near LA	08/10	1	UF	RO/TOT	^{241}Am	3.038	0.148	0.050	pCi/L	30	0.10	2.53	1.2	DOE Drinking Water DCG
LA Canyon near LA	04/30	1	UF	RO/TOT	Beta	85.2	10.1		pCi/L	1,000	0.09	1.70	50	EPA Screening Level
LA Canyon near LA	07/08	1	UF	RO/TOT	Beta	191.0	55.1		pCi/L	1,000	0.19	3.82	50	EPA Screening Level
LA Canyon near LA	04/30	1	F	RO/D	^{137}Cs	0.93	0.18	0.09	pCi/L					
LA Canyon near LA	04/30	1	UF	RO/TOT	^{137}Cs	4.02	0.40	0.08	pCi/L					
LA Canyon near LA	05/03	1	UF	RO/TOT	^{137}Cs	1.81	0.36	0.93	pCi/L					
LA Canyon near LA	07/08	1	UF	RO/TOT	^{137}Cs	42.27	5.04	2.78	pCi/L					
LA Canyon near LA	08/09	1	UF	RO/TOT	^{137}Cs	10.32	2.53	4.57	pCi/L					
LA Canyon near LA	08/10	1	UF	RO/TOT	^{137}Cs	7.23	1.48	2.37	pCi/L					
LA Canyon near LA	04/30	1	UF	RO/TOT	^{238}Pu	0.106	0.028	0.074	pCi/L					
LA Canyon near LA	05/03	1	UF	RO/TOT	^{238}Pu	0.184	0.038	0.057	pCi/L					
LA Canyon near LA	07/08	1	UF	RO/TOT	^{238}Pu	1.531	0.122	0.071	pCi/L					
LA Canyon near LA	08/09	1	UF	RO/TOT	^{238}Pu	0.222	0.040	0.060	pCi/L					
LA Canyon near LA	08/10	1	UF	RO/TOT	^{238}Pu	0.220	0.040	0.072	pCi/L					
LA Canyon near LA	04/30	1	F	RO/D	^{239,240}Pu	0.033	0.009	0.013	pCi/L					
LA Canyon near LA	08/10	1	F	RO/D	^{239,240}Pu	0.112	0.023	0.054	pCi/L					
LA Canyon near LA	04/30	1	UF	RO/TOT	^{239,240}Pu	1.787	0.101	0.063	pCi/L	30	0.06	1.49	1.2	DOE Drinking Water DCG
LA Canyon near LA	05/03	1	UF	RO/TOT	^{239,240}Pu	1.568	0.116	0.060	pCi/L	30	0.05	1.31	1.2	DOE Drinking Water DCG
LA Canyon near LA	07/08	1	UF	RO/TOT	^{239,240}Pu	15.778	0.638	0.078	pCi/L	30	0.53	13.15	1.2	DOE Drinking Water DCG
LA Canyon near LA	08/09	1	UF	RO/TOT	^{239,240}Pu	2.471	0.149	0.045	pCi/L	30	0.08	2.06	1.2	DOE Drinking Water DCG
LA Canyon near LA	08/10	1	UF	RO/TOT	^{239,240}Pu	5.291	0.235	0.036	pCi/L	30	0.18	4.41	1.2	DOE Drinking Water DCG
LA Canyon near LA	07/13	1	UF	RO/TOT	U	8.20	0.70		µg/L					
LA Canyon near LA	08/09	1	UF	RO/TOT	U	7.33	0.73		µg/L					
North Fork Ancho Canyon at TA-39	09/16	1	UF	RO/TOT	^{241}Am	0.196	0.033	0.056	pCi/L					
North Fork Ancho Canyon at TA-39	09/16	1	UF	RO/TOT	Gamma	159	49	80	pCi/L					

Table 5-3. Detections of Radionuclides[a] and Comparison to Department of Energy Derived Concentration Guides[b] in Surface Water and Runoff Samples for 1999 (Cont.)

Station Name	Date	Code[c]	F/UF[d]	Matrix[e]	Analyte	Value	Uncertainty[f]	Detection Limit	Units	DOE DCG	Ratio of Value to DCG	Ratio of Value to Minimum Standard	Minimum Standard	Minimum Standard Type
North Fork Ancho Canyon at TA-39	09/16	1	UF	RO/TOT	^{238}Pu	0.050	0.015	0.024	pCi/L					
North Fork Ancho Canyon at TA-39	09/16	1	UF	RO/TOT	^{239,240}Pu	0.137	0.025	0.024	pCi/L					
North Fork Ancho Canyon at TA-39	09/16	1	UF	RO/TOT	U	8.80	0.90		µg/L					
Pajarito Canyon above SR-4	06/17	1	UF	RO/TOT	^{241}Am	7.853	0.238	0.023	pCi/L	30	0.26	6.54	1.2	DOE Drinking Water DCG
Pajarito Canyon above SR-4	06/17	1	UF	RO/TOT	^{238}Pu	0.100	0.031	0.086	pCi/L					
Pajarito Canyon above SR-4	06/17	1	F	RO/D	^{239,240}Pu	0.444	0.041	0.017	pCi/L					
Pajarito Canyon above SR-4	06/17	1	UF	RO/TOT	^{239,240}Pu	1.565	0.109	0.055	pCi/L	30	0.05	1.30	1.2	DOE Drinking Water DCG
Pajarito Canyon above Threemile Canyon	09/16	1	F	RO/D	^{137}Cs	29.43	8.43	3.87	pCi/L					
Pajarito Canyon above Threemile Canyon	09/16	1	UF	RO/TOT	^{239,240}Pu	0.088	0.027	0.051	pCi/L					
Potrillo Canyon near White Rock	08/31	1	UF	RO/TOT	^{241}Am	0.085	0.023	0.051	pCi/L					
Potrillo Canyon near White Rock	09/16	1	UF	RO/TOT	^{241}Am	0.055	0.017	0.034	pCi/L					
Potrillo Canyon near White Rock	08/31	1	UF	RO/TOT	^{137}Cs	3.85	1.22	2.11	pCi/L					
Potrillo Canyon near White Rock	08/31	1	UF	RO/TOT	Gamma	470	51	80	pCi/L					
Potrillo Canyon near White Rock	09/16	1	UF	RO/TOT	Gamma	147	49	80	pCi/L					
Potrillo Canyon near White Rock	08/31	1	UF	RO/TOT	^{239,240}Pu	0.431	0.067	0.076	pCi/L					
Sandia Canyon below Power Plant	05/28	1	UF	RO/TOT	Alpha	24.3	5.8		pCi/L	30	0.81	1.62	15	EPA Primary Drinking Water Standard
Sandia Canyon below Power Plant	05/28	1	UF	RO/TOT	Beta	30.2	5.4		pCi/L					
Sandia Canyon below Wetlands	07/12	1	UF	RO/TOT	Beta	36.0	12.0		pCi/L					
Sandia Canyon below Wetlands	07/12	1	UF	RO/TOT	^{238}Pu	1.183	0.079	0.050	pCi/L					
Sandia Canyon near Roads & Grounds at TA-3	05/28	1	UF	RO/TOT	Alpha	19.6	4.9		pCi/L	30	0.65	1.31	15	EPA Primary Drinking Water Standard

Table 5-3. Detections of Radionuclides[a] and Comparison to Department of Energy Derived Concentration Guides[b] in Surface Water and Runoff Samples for 1999 (Cont.)

Station Name	Date	Code[c]	F/UF[d]	Matrix[e]	Analyte	Value	Uncertainty[f]	Detection Limit	Units	DOE DCG	Ratio of Value to DCG	Ratio of Value to Minimum Standard	Minimum Standard	Minimum Standard Type
Sandia Canyon near Roads & Grounds at TA-3	07/14	1	UF	RO/TOT	^{241}Am	0.045	0.011	0.014	pCi/L					
Sandia Canyon near Roads & Grounds at TA-3	05/28	1	UF	RO/TOT	Beta	25.8	4.9		pCi/L					
Acid Weir	06/23	1	UF	SW	^{241}Am	0.033	0.009	0.022	pCi/L					
Acid Weir	06/23	1	UF	SW	^{239,240}Pu	0.528	0.045	0.036	pCi/L					
Frijoles at Rio Grande	12/22	1	UF	SW	Gamma	286	50	0	pCi/L					
Jemez River	08/02	1	UF	SW	^{241}Am	0.039	0.011	0.035	pCi/L					
Jemez River	08/02	1	UF	SW	Gamma	154	51	80	pCi/L					
Los Alamos at Upper GS	05/26	1	UF	SW	^{239,240}Pu	0.051	0.015	0.028	pCi/L					
Mortandad at GS-1	05/27	1	UF	SW	Alpha	27.5	9.1		pCi/L	30	0.92	1.83	15	EPA Primary Drinking Water Standard
Mortandad at GS-1	05/27	1	UF	SW	^{241}Am	4.438	0.154	0.048	pCi/L	30	0.15	3.70	1.2	DOE Drinking Water DCG
Mortandad at GS-1	05/27	1	UF	SW	Beta	81.6	19.9		pCi/L	1,000	0.08	1.63	50	EPA Screening Level
Mortandad at GS-1	05/27	1	UF	SW	^{3}H	2,480	760	410	pCi/L					
Mortandad at GS-1	05/27	1	UF	SW	^{238}Pu	8.108	0.250	0.028	pCi/L	40	0.20	5.07	1.6	DOE Drinking Water DCG
Mortandad at GS-1	05/27	1	UF	SW	^{239,240}Pu	3.757	0.140	0.032	pCi/L	30	0.13	3.13	1.2	DOE Drinking Water DCG
Mortandad at GS-1	05/27	1	UF	SW	^{137}Cs	28.63	3.54	2.21	pCi/L					
Pueblo at SR-502	08/04	1	UF	SW	Gamma	175	51	80	pCi/L					
Pueblo at SR-502	08/04	1	UF	SW	^{239,240}Pu	0.129	0.020	0.016	pCi/L					
Rio Chama at Chamita	06/16	1	UF	SW	^{241}Am	0.063	0.015	0.030	pCi/L					
Rio Chama at Chamita	06/16	1	UF	SW	^{241}Am	0.036	0.010	0.018	pCi/L					
Rio Grande at Otowi (bank)	08/03	1	UF	SW	Gamma	184	51	80	pCi/L					
Rio Grande at Otowi Upper (bank)	08/03	1	UF	SW	Gamma	154	51	80	pCi/L					
SCS-3	06/16	1	UF	SW	^{238}Pu	0.208	0.034	0.042	pCi/L					

[a] Detection defined as value ≥ 3× uncertainty and ≥ detection limit, except values shown for uranium ≥ 5 µg/L, for gross alpha ≥ 5 pCi/L, and for gross beta ≥ 20 pCi/L.
[b] Values indicated by entries in righthand columns are greater than the minimum standard shown. The minimum standard is either a DOE DCG for DOE-administered drinking water systems or an EPA drinking water standard.
[c] Codes: 1–primary analysis; 2–secondary analysis; R–lab replicate; D–lab duplicate.
[d] F/UF: F–filtered; UF–unfiltered.
[e] Matrix: SW–surface water; RO–runoff; D–dissolved; TOT–total.
[f] One standard deviation radioactivity counting uncertainty.

Table 5-4. Detections of Strontium-90[a] and Comparison to Department of Energy Derived Concentration Guides[b] in Surface Water and Runoff Samples for 1999
(LANL's 1999 strontium-90 data are not valid because of analytical laboratory problems; the data appear in this report for documentary purposes only.)

Station Name	Date	Code[c]	F/UF[d]	Matrix[e]	Analyte	Value	Uncertainty[f]	Detection Limit	Units	DOE DCG	Ratio of Value to DCG	Ratio of Value to Minimum Standard	Minimum Standard	Minimum Standard Type
Ancho Canyon at TA-39	08/04	1	UF	RO/TOT	^{90}Sr	73.77	4.58	1.63	pCi/L	1,000	0.07	9.22	8	EPA Primary Drinking Water Standard
Ancho Canyon at TA-39	08/10	1	UF	RO/TOT	^{90}Sr	63.58	4.00	1.55	pCi/L	1,000	0.06	7.95	8	EPA Primary Drinking Water Standard
Ancho Canyon near Bandelier	07/08	1	F	RO/D	^{90}Sr	0.79	0.24	0.44	pCi/L					
Ancho Canyon near Bandelier	06/18	1	UF	RO/TOT	^{90}Sr	60.95	3.27	0.54	pCi/L	1,000	0.06	7.62	8	EPA Primary Drinking Water Standard
Ancho Canyon near Bandelier	07/08	1	UF	RO/TOT	^{90}Sr	19.98	1.19	0.42	pCi/L	1,000	0.02	2.50	8	EPA Primary Drinking Water Standard
Cañada del Buey at WR	06/17	1	UF	RO/TOT	^{90}Sr	58.82	3.05	0.29	pCi/L	1,000	0.06	7.35	8	EPA Primary Drinking Water Standard
Cañada del Buey at WR	08/06	1	UF	RO/TOT	^{90}Sr	36.37	2.22	0.74	pCi/L	1,000	0.04	4.55	8	EPA Primary Drinking Water Standard
Cañada del Buey at WR	08/23	1	UF	RO/TOT	^{90}Sr	55.07	3.18	0.75	pCi/L	1,000	0.06	6.88	8	EPA Primary Drinking Water Standard
DP Canyon near Los Alamos	06/23	1	F	RO/D	^{90}Sr	10.05	0.66	0.35	pCi/L	1,000	0.01	1.26	8	EPA Primary Drinking Water Standard
DP Canyon near Los Alamos	06/23	1	UF	RO/TOT	^{90}Sr	32.25	1.73	0.29	pCi/L	1,000	0.03	4.03	8	EPA Primary Drinking Water Standard
DP Canyon near Los Alamos	08/14	1	UF	RO/TOT	^{90}Sr	14.17	1.11	0.82	pCi/L	1,000	0.01	1.77	8	EPA Primary Drinking Water Standard
G-SWMS-1	07/29	1	UF	RO/TOT	^{90}Sr	21.67	1.24	0.34	pCi/L	1,000	0.02	2.71	8	EPA Primary Drinking Water Standard
G-SWMS-2	05/24	1	UF	RO/TOT	^{90}Sr	33.82	1.82	0.30	pCi/L	1,000	0.03	4.23	8	EPA Primary Drinking Water Standard
G-SWMS-2	07/08	1	UF	RO/TOT	^{90}Sr	11.91	0.71	0.27	pCi/L	1,000	0.01	1.49	8	EPA Primary Drinking Water Standard
G-SWMS-2	07/29	1	UF	RO/TOT	^{90}Sr	12.11	0.95	0.68	pCi/L	1,000	0.01	1.51	8	EPA Primary Drinking Water Standard
G-SWMS-3	07/29	1	F	RO/D	^{90}Sr	0.69	0.18	0.33	pCi/L					
G-SWMS-3	05/28	1	UF	RO/TOT	^{90}Sr	101.40	5.15	0.33	pCi/L	1,000	0.10	12.68	8	EPA Primary Drinking Water Standard
G-SWMS-3	06/17	1	UF	RO/TOT	^{90}Sr	76.50	4.00	0.46	pCi/L	1,000	0.08	9.56	8	EPA Primary Drinking Water Standard
G-SWMS-3	07/15	1	UF	RO/TOT	^{90}Sr	43.97	2.58	0.86	pCi/L	1,000	0.04	5.50	8	EPA Primary Drinking Water Standard
G-SWMS-3	07/29	1	UF	RO/TOT	^{90}Sr	10.82	0.71	0.37	pCi/L	1,000	0.01	1.35	8	EPA Primary Drinking Water Standard

Table 5-4. Detections of Strontium-90[a] and Comparison to Department of Energy Derived Concentration Guides[b] in Surface Water and Runoff Samples for 1999 (Cont.)
(LANL's 1999 strontium-90 data are not valid because of analytical laboratory problems; the data appear in this report for documentary purposes only.)

Station Name	Date	Code[c]	F/UF[d]	Matrix[e]	Analyte	Value	Uncertainty[f]	Detection Limit	Units	DOE DCG	Ratio of Value to DCG	Ratio of Value to Minimum Standard	Minimum Standard	Minimum Standard Type
G-SWMS-4	05/22	1	UF	RO/TOT	^{90}Sr	7.74	0.53	0.30	pCi/L					
G-SWMS-4	06/21	1	UF	RO/TOT	^{90}Sr	2.08	0.25	0.34	pCi/L					
G-SWMS-4	07/15	1	UF	RO/TOT	^{90}Sr	2.26	0.26	0.34	pCi/L					
G-SWMS-5	06/17	1	UF	RO/TOT	^{90}Sr	28.48	1.53	0.26	pCi/L	1,000	0.03	3.56	8	EPA Primary Drinking Water Standard
G-SWMS-5	07/08	1	UF	RO/TOT	^{90}Sr	6.39	0.45	0.29	pCi/L					
G-SWMS-6	05/24	1	UF	RO/TOT	^{90}Sr	13.91	0.83	0.30	pCi/L	1,000	0.01	1.74	8	EPA Primary Drinking Water Standard
G-SWMS-6	06/13	1	UF	RO/TOT	^{90}Sr	15.15	0.87	0.25	pCi/L	1,000	0.02	1.89	8	EPA Primary Drinking Water Standard
G-SWMS-6	07/08	1	UF	RO/TOT	^{90}Sr	16.33	0.94	0.27	pCi/L	1,000	0.02	2.04	8	EPA Primary Drinking Water Standard
G-SWMS-6	07/29	1	UF	RO/TOT	^{90}Sr	20.00	1.14	0.31	pCi/L	1,000	0.02	2.50	8	EPA Primary Drinking Water Standard
G-SWMS-6	08/14	1	UF	RO/TOT	^{90}Sr	5.59	0.65	0.81	pCi/L					
G-SWMS-6	08/31	1	UF	RO/TOT	^{90}Sr	14.49	1.01	0.55	pCi/L	1,000	0.01	1.81	8	EPA Primary Drinking Water Standard
LA Canyon near LA	04/30	1	F	RO/D	^{90}Sr	5.47	0.42	0.32	pCi/L					
LA Canyon near LA	05/03	1	F	RO/D	^{90}Sr	3.31	0.30	0.31	pCi/L					
LA Canyon near LA	07/08	1	F	RO/D	^{90}Sr	5.15	0.41	0.35	pCi/L					
LA Canyon near LA	08/09	1	F	RO/D	^{90}Sr	2.31	0.31	0.42	pCi/L					
LA Canyon near LA	08/10	1	F	RO/D	^{90}Sr	3.22	0.81	1.47	pCi/L					
LA Canyon near LA	04/30	1	UF	RO/TOT	^{90}Sr	32.06	1.74	0.30	pCi/L	1,000	0.03	4.01	8	EPA Primary Drinking Water Standard
LA Canyon near LA	05/03	1	UF	RO/TOT	^{90}Sr	4.28	0.37	0.35	pCi/L					
LA Canyon near LA	07/08	1	UF	RO/TOT	^{90}Sr	32.91	1.75	0.26	pCi/L	1,000	0.03	4.11	8	EPA Primary Drinking Water Standard
LA Canyon near LA	08/09	1	UF	RO/TOT	^{90}Sr	29.80	1.67	0.39	pCi/L	1,000	0.03	3.72	8	EPA Primary Drinking Water Standard
LA Canyon near LA	08/10	1	UF	RO/TOT	^{90}Sr	36.76	2.29	0.84	pCi/L	1,000	0.04	4.59	8	EPA Primary Drinking Water Standard
Pajarito Canyon above SR-4	06/17	1	F	RO/D	^{90}Sr	0.46	0.14	0.27	pCi/L					
Pajarito Canyon above SR-4	06/17	1	UF	RO/TOT	^{90}Sr	10.26	0.64	0.27	pCi/L	1,000	0.01	1.28	8	EPA Primary Drinking Water Standard
Potrillo Canyon near White Rock	08/31	1	UF	RO/TOT	^{90}Sr	14.17	0.96	0.49	pCi/L	1,000	0.01	1.77	8	EPA Primary Drinking Water Standard

Table 5-4. Detections of Strontium-90[a] and Comparison to Department of Energy Derived Concentration Guides[b] in Surface Water and Runoff Samples for 1999 (Cont.)
(LANL's 1999 strontium-90 data are not valid because of analytical laboratory problems; the data appear in this report for documentary purposes only.)

Station Name	Date	Code[c]	F/UF[d]	Matrix[e]	Analyte	Value	Uncertainty[f]	Detection Limit	Units	DOE DCG	Ratio of Value to DCG	Ratio of Value to Minimum Standard	Minimum Standard	Minimum Standard Type
Sandia Canyon below Power	05/28	1	UF	RO/TOT	^{90}Sr	6.95	0.47	0.26	pCi/L					
Sandia Canyon below	07/12	1	UF	RO/TOT	^{90}Sr	3.94	0.34	0.32	pCi/L					
Sandia Canyon near Roads & Grounds at TA-3	05/28	1	UF	RO/TOT	^{90}Sr	5.56	0.39	0.25	pCi/L					
Sandia Canyon near Roads & Grounds at TA-3	07/14	1	UF	RO/TOT	^{90}Sr	1.57	0.22	0.32	pCi/L					
Sandia Canyon near Roads & Grounds at TA-3	08/10	1	UF	RO/TOT	^{90}Sr	4.33	0.81	1.33	pCi/L					
Acid Weir	06/23	1	UF	SW	^{90}Sr	1.33	0.21	0.33	pCi/L					
Los Alamos at Upper GS	05/26	1	UF	SW	^{90}Sr	2.85	0.27	0.30	pCi/L					
Los Alamos Canyon Reservoir	06/23	1	UF	SW	^{90}Sr	8.66	0.57	0.31	pCi/L	1,000	0.01	1.08	8	EPA Primary Drinking Water Standard
Mortandad at GS-1	05/27	1	UF	SW	^{90}Sr	16.45	0.96	0.31	pCi/L	1,000	0.02	2.06	8	EPA Primary Drinking Water Standard
Pueblo 1	06/23	1	UF	SW	^{90}Sr	21.36	1.19	0.27	pCi/L	1,000	0.02	2.67	8	EPA Primary Drinking Water Standard
Rio Chama at Chamita	06/16	1	UF	SW	^{90}Sr	0.66	0.19	0.36	pCi/L					
Rio Chama at Chamita	06/16	1	UF	SW	^{90}Sr	0.70	0.18	0.34	pCi/L					
Rio Grande at Otowi (bank)	08/03	1	UF	SW	^{90}Sr	1.76	0.46	0.82	pCi/L					
SCS-1	05/27	1	UF	SW	^{90}Sr	3.57	0.34	0.37	pCi/L					
SCS-3	06/16	1	UF	SW	^{90}Sr	0.67	0.18	0.35	pCi/L					

[a] Detection defined as value ≥ 3× uncertainty and ≥ detection limit, except values shown for uranium ≥ 5 µg/L, for gross alpha ≥ 5 pCi/L, and for gross beta ≥ 20 pCi/L.
[b] Values indicated by entries in righthand columns are greater than the minimum standard shown. The minimum standard is either a DOE DCG for DOE-administered drinking water systems or an EPA drinking water standard.
[c] Codes: 1–primary analysis; 2–secondary analysis; R–lab replicate; D–lab duplicate.
[d] F/UF: F–filtered; UF–unfiltered.
[e] Matrix: SW–surface water; RO–runoff; D–dissolved; TOT–total.
[f] One standard deviation radioactivity counting uncertainty.

Table 5-5 Summary of TA-50 Radionuclide, Nitrate, and Fluoride Discharges[a]

	1963–1977	1997			1998			1999		
Radionuclide	Total Activity Released (mCi)[b]	Total Annual Activity (mCi)	Mean Activity (pCi/L)	Ratio of Activity to DCG[c]	Total Annual Activity (mCi)	Mean Activity (pCi/L)	Ratio of Activity to DCG[c]	Total Annual Activity (mCi)	Mean Activity (pCi/L)	Ratio of Activity to DCG[c]
^{3}H	25,150	1,330	76,300	0.04	1,228	52,840	0.03	485	24,252	0.01
^{241}Am	7	2.56	147	4.90	2	99.1	3.30	1.1	55.0	1.83
^{137}Cs	848	2.48	142	0.05	1	43.4	0.01	1.5	76.9	0.026
^{238}Pu	51	1.34	76.7	1.92	2	97.9	2.45	2.4	121.3	3.03
$^{239,240}Pu$	39	0.80	45.9	1.53	0.91	39	1.30	1.40	70.0	2.33
^{89}Sr	<1	0.83	47.7	0.002	2	86.8	0.004	0.36	18.2	0.0009
^{90}Sr	295	0.50	28.5	0.03	0.82	35.3	0.04	0.52	26.0	0.026
^{234}U	NA	0.08	4.88	0.01	0.12	5.1	0.01	0.17	8.6	0.017
^{235}U	2	0.007	0.44	0.0007	0.053	2.3	0.004	0.0047	0.24	0.0004
Constituent		**Total Annual Mass (kg)**	**Mean Concentration (mg/L)**	**Ratio of Concentration to MCL[d]**	**Total Annual Mass (kg)**	**Mean Concentration (mg/L)**	**Ratio of Concentration to MCL[d]**	**Total Annual Mass (kg)**	**Mean Concentration (mg/L)**	**Ratio of Concentration to MCL[d]**
NO_3-N		1,220	69.6	7.0	1,420	61.1	6.1	486	24.2	2.4
F		34.9	2.00	1.2	37.6	1.62	1.0	22.6	1.12	0.7
Total effluent volume ($\times 10^7$ liters)		1.75			2.32			2.00		

[a]Compiled from Radioactive Liquid Waste Group (FWO-RLW) Annual Reports. Data for 1999 are preliminary.
[b]DOE 1979; decay corrected through 12/77.
[c]Public dose limit.
[d]New Mexico Groundwater Limit.

Table 5-6. Chemical Quality of Surface Water and Runoff Samples for 1999 (mg/L[a])

Station Name	Date	Matrix[b]	F/UF[c]	SiO_2	Ca	Mg	K	Na	Cl	SO_4	CO_3 Alkalinity	Total Alkalinity	F	PO_4-P	NO_3-N	CN	TDS[d]	TSS[e]	Hardness as $CaCO_3$	pH[f]	Conductance (µS/cm)
Regional Stations																					
Rio Chama at Chamita	06/16	RO/TOT	F	14	40.7	7.8	<0.7[g]	15.8	3.8	59.5	<5	85	0.14	<0.03	<0.01		196		134.0	8.3	316
Rio Chama at Chamita	06/16	SW	F	14	38.7	7.5	1.1	14.9	3.8	53.0	<5	78	0.16	<0.03	<0.01		210		127.5	8.3	316
Rio Chama at Chamita	06/16	SW	UF													<0.01		20			
Rio Chama at Chamita	06/16	SW	UF													<0.01		16			
Rio Grande at Embudo	10/05	SW	F	24	25.9	5.0	3.0	15.4	3.9	26.2	<5	84	0.34	0.06	0.06		150		85.1	8.1	200
Rio Grande at Embudo	10/05	SW	UF													0.04		11			
Rio Grande at Otowi Upper (bank)	08/03	SW	F	21	28.5	4.9	2.4	13.9	3.6	34.1	<5	86	0.29	<0.03	0.09		160		91.3	8.2	238
Rio Grande at Otowi Upper (bank)	08/03	SW	UF													0.04		1,366			
Rio Grande at Otowi (bank)	08/03	SW	F		28.1	4.8	1.9	14.0							<0.03	0.11				89.8	
Rio Grande at Otowi (bank)	08/03	SW	UF													0.01		374			
Rio Grande at Otowi (bank)	08/04	SW	F	21					3.7	34.4	<5	83	0.30					168		7.1	235
Rio Grande at Frijoles (bank)	09/22	SW	F	23	28.5	5.0	2.4	14.0	3.7	30.1	<5	84	0.28	<0.03	0.02		172		91.6	8.2	243
Rio Grande at Frijoles (bank)	09/22	SW	F	23	28.8	5.0	2.1	14.0	3.8	30.1	<5	88	0.30	<0.03	0.02		162		92.7	8.2	243
Rio Grande at Frijoles (bank)	09/22	SW	UF													0.02		129			
Rio Grande at Frijoles (bank)	09/22	SW	UF													0.01		98			
Rio Grande at Cochiti	09/20	SW	F											<0.03	0.02						
Rio Grande at Cochiti	09/23	SW	F	23	25.4	4.3	2.9	12.6	3.8	30.0	<5	92	0.30				182		81.2	8.2	231
Rio Grande at Cochiti	09/23	SW	UF													0.01		142			
Jemez River	08/02	SW	F	16	26.5	2.3	1.2	5.0	1.8	2.5	<5	84	0.23				110		75.4	8.0	159
Jemez River	08/02	SW	F	15	26.3	2.3	1.4	5.1	1.8	2.4	<5	81	0.24				108		75.2	7.9	160
Jemez River	08/02	SW	UF													0.04					
Jemez River	08/02	SW	UF													0.02		198			
Jemez River	08/03	SW	F											<0.03	0.02						
Jemez River	08/04	SW	UF															196			
Pararito Plateau																					
Guaje Canyon:																					
Guaje Canyon	11/16	SW	F	50	6.0	2.1	1.8	6.0	<1.0	2.4	<5	36	0.12	0.05	0.10		88		23.6	7.4	74
Guaje Canyon	11/16	SW	UF													0.03		1			
Acid/Pueblo Canyon:																					
Acid Weir	06/23	SW	F	21	16.3	1.7	4.0	29.5	45.0	5.2	<5	44	0.21	0.27	0.66		138		47.8	6.9	260
Acid Weir	06/23	SW	UF													<0.01		10			
Pueblo 1	06/23	SW	F	18	13.1	2.2	3.5	27.8	31.2	5.9	<5	54	0.14	0.32	0.03		126		41.6	7.5	226
Pueblo 1	06/23	SW	UF													<0.01		2			
Pueblo 3	05/20	SW	F	76	28.3	7.0	11.3	67.6	42.8	11.0	<5	231	0.68	6.56	0.40		364		99.3	7.8	605
Pueblo 3	05/20	SW	UF													0.01		3.4			

Table 5-6. Chemical Quality of Surface Water and Runoff Samples for 1999 (mg/L[a]) (Cont.)

Station Name	Date	Matrix[b]	F/UF[c]	SiO_2	Ca	Mg	K	Na	Cl	SO_4	CO_3 Alkalinity	Total Alkalinity	F	PO_4-P	NO_3-N	CN	TDS[d]	TSS[e]	Hardness as $CaCO_3$	pH[f]	Conductance (µS/cm)
Pararito Plateau (Cont.)																					
Acid/Pueblo Canyon: (Cont.)																					
Pueblo at SR-502	08/02	SW	UF															<1			
Pueblo at SR-502	12/01	SW	UF															76			
DP/Los Alamos Canyon:																					
Los Alamos Canyon Reservoir	06/23	SW	F	33	7.5	2.5	2.3	6.0	5.8	3.8	<5	30	0.07	0.09	<0.01		80		29.0	8.4	88
Los Alamos Canyon Reservoir	06/23	SW	UF													<0.01		<1			
Los Alamos at Upper Gaging Station	05/26	SW	UF															2			
Sandia Canyon:																					
SCS-1	05/27	SW	F	94	21.1	6.2	10.9	101.7	87.0	46.0	<5	128	0.37	3.25	4.77		484		78.3	8.2	684
SCS-1	05/27	SW	UF													0.03		28			
SCS-2	05/19	SW	F	83	23.1	5.6	13.4	153.1	101.0	138.0	<5	165	0.64	3.38	1.72		642		80.9	8.5	917
SCS-2	05/19	SW	UF													0.02		2.4			
SCS-3	06/16	SW	F	80	19.8	4.8	10.1	109.7	75.4	63.8	<5	132	0.51	3.10	2.95		456		69.1	8.6	686
SCS-3	06/16	SW	UF													<0.01		13			
Mortandad Canyon:																					
Mortandad at Gaging Station 1	05/27	SW	F	65	30.8	3.0	4.9	28.4	8.0	10.4	<5	122	0.74	0.36	2.54		240		89.5	8.0	302
Mortandad at Gaging Station 1	05/27	SW	UF													0.03		<1			
Mortandad at Rio Grande (A-11)	09/20	SW	F	83	29.2	5.6	13.5	68.5	57.7	34.0	<5	129	0.42				388		96.2	8.0	563
Mortandad at Rio Grande (A-11)	09/20	SW	UF													0.01		6			
Mortandad at Rio Grande (A-11)	09/23	SW	F											0.98	5.06						
Pajarito Canyon:																					
Pajarito at Rio Grande	09/21	SW	F	69	20.3	4.2	2.7	12.2	4.4	5.4	<5	87	0.43	<0.03	0.66		170		68.1	8.3	197
Pajarito at Rio Grande	09/21	SW	UF													0.01		<1			
Water Canyon:																					
Water Canyon at Beta	11/17	SW	F	39	11.7	3.6	3.5	15.0	14.0	2.4	<5	63	0.13	0.07	0.01		142		44.3	7.1	153
Water Canyon at Beta	11/17	SW	UF													0.03		4			
Ancho Canyon:																					
Ancho at Rio Grande	09/21	SW	F	76	14.7	3.4	2.1	9.8	3.4	1.9	<5	74	0.34	<0.03	0.05		150		50.4	8.4	143
Ancho at Rio Grande	09/21	SW	UF													0.01		2			
Frijoles Canyon:																					
Frijoles at Monument Headquarters	12/22	SW	F	64	7.7	2.5	2.6	9.1	2.4	1.7	<5	48	0.11	<0.02	0.07		102		29.7	7.6	108
Frijoles at Monument Headquarters	12/22	SW	UF													0.04		1			
Frijoles at Rio Grande	12/22	SW	F	62	8.0	2.6	2.9	9.3	2.8	1.7	<5	45	0.13	<0.02	0.05		90		30.9	7.6	108
Frijoles at Rio Grande	12/22	SW	UF													0.03		15			

Table 5-6. Chemical Quality of Surface Water and Runoff Samples for 1999 (mg/L[a]) (Cont.)

Station Name	Date	Matrix[b]	F/UF[c]	SiO_2	Ca	Mg	K	Na	Cl	SO_4	CO_3 Alkalinity	Total Alkalinity	F	PO_4-P	NO_3-N	CN	TDS[d]	TSS[e]	Hardness as $CaCO_3$	pH[f]	Conductance (µS/cm)
Runoff Stations																					
Perimeter:																					
LA Canyon near Los Alamos	04/30	RO/D	F	12	12.0	1.8	3.0	15.0	36.8	4.0	<5	41	0.13				182		37.4	7.8	157
LA Canyon near Los Alamos	04/30	RO/TOT	UF															3,900			
LA Canyon near Los Alamos	05/03	RO/D	F	34	11.0	2.5	2.1	15.0	23.2	4.0	<5	34	0.06	0.18	0.06		92		37.8	7.5	159
LA Canyon near Los Alamos	05/03	RO/TOT	UF													0.01		654			
LA Canyon near Los Alamos	07/08	RO/TOT	UF															11,625			
LA Canyon near Los Alamos	08/09	RO/D	F		18.6	2.4	4.2	6.0													
LA Canyon near Los Alamos	08/09	RO/TOT	UF		77.2	14.1	12.2	7.8										25,575			
LA Canyon near Los Alamos	08/10	RO/TOT	UF															3,340			
LA Canyon near Los Alamos	08/10	RO/TOT	UF															3,836			
LA Canyon below TA-2	09/16	RO/TOT	UF															4,270			
LA Canyon below TA-2	09/16	RO/TOT	UF															7,840			
DP Canyon near Los Alamos	06/23	RO/TOT	UF													<0.01		3,304			
DP Canyon near Los Alamos	06/23	RO/TOT	UF															3,160			
DP Canyon near Los Alamos	08/14	RO/TOT	UF															1,132			
DP Canyon near Los Alamos	08/14	RO/TOT	UF															968			
DP Canyon near Los Alamos	09/16	RO/TOT	UF															4,730			
DP Canyon near Los Alamos	09/16	RO/TOT	UF															13,610			
Sandia Canyon below Power Plant	05/28	RO/TOT	UF															1,430			
Sandia Canyon below Power Plant	07/14	RO/TOT	UF															656			
Sandia Canyon below Power Plant	07/14	RO/TOT	UF															720			
Sandia Canyon below Wetlands	07/14	RO/TOT	UF															1,393			
Sandia Canyon below Wetlands	07/18	RO/TOT	UF															1,368			
Sandia Canyon below Wetlands	07/18	RO/TOT	UF															1,536			
Sandia Canyon below Wetlands	08/10	RO/TOT	UF															422			
Sandia Canyon below Wetlands	08/10	RO/TOT	UF															508			
Sandia Canyon near Roads & Grounds at TA-3	05/28	RO/TOT	UF															870			
Sandia Canyon near Roads & Grounds at TA-3	07/14	RO/TOT	UF															160			
Sandia Canyon near Roads & Grounds at TA-3	07/14	RO/TOT	UF															160			
Sandia Canyon near Roads & Grounds at TA-3	08/10	RO/TOT	UF															1,676			
Sandia Canyon near Roads & Grounds at TA-3	08/10	RO/TOT	UF															2,202			
Sandia Canyon Truck Route	09/14	RO/TOT	UF															5,100			
Sandia Canyon Truck Route	09/14	RO/TOT	UF															2,960			

Table 5-6. Chemical Quality of Surface Water and Runoff Samples for 1999 (mg/L[a]) (Cont.)

Station Name	Date	Matrix[b]	F/UF[c]	SiO_2	Ca	Mg	K	Na	Cl	SO_4	CO_3 Alkalinity	Total Alkalinity	F	PO_4-P	NO_3-N	CN	TDS[d]	TSS[e]	Hardness as $CaCO_3$	pH[f]	Conductance (µS/cm)
Runoff Stations (Cont.)																					
Perimeter: (Cont.)																					
Cañada del Buey at White Rock	06/17	RO/D	F	5	8.8	1.2	2.4	1.2	1.0	1.4	<5	33	0.10	0.12	0.20		38		26.9	7.5	56
Cañada del Buey at White Rock	06/17	RO/TOT	UF		120.8	13.4	12.5	1.6								<0.01		11,292			
Cañada del Buey at White Rock	06/17	RO/TOT	UF															18,380			
Cañada del Buey at White Rock	07/08	RO/TOT	UF															6,812			
Cañada del Buey at White Rock	07/08	RO/TOT	UF															5,368			
Cañada del Buey at White Rock	08/06	RO/TOT	UF															14,625			
Cañada del Buey at White Rock	08/06	RO/TOT	UF															15,150			
Cañada del Buey at White Rock	08/23	RO/TOT	UF															25,420			
Cañada del Buey at White Rock	08/23	RO/TOT	UF															20,500			
Cañada del Buey at White Rock	09/16	RO/TOT	UF															12,520			
Cañada del Buey at White Rock	09/16	RO/TOT	UF															22,290			
Pajarito Canyon above Threemile Canyon	09/16	RO/TOT	UF															2,000			
Pajarito Canyon above Threemile Canyon	09/16	RO/TOT	UF															1,030			
Pajarito Canyon above SR-4	06/17	RO/D	F	9	7.7	1.9	5.4	8.7	10.8	7.9	<5	23	0.13	0.11	0.28		78		27.0	7.0	118
Pajarito Canyon above SR-4	06/17	RO/TOT	UF		15.7	7.3	10.1	9.6								<0.01		1,120			
Pajarito Canyon above SR-4	06/17	RO/TOT	UF															2,492			
Potrillo Canyon near White Rock	08/31	RO/TOT	UF															6,430			
Potrillo Canyon near White Rock	08/31	RO/TOT	UF															6,150			
Potrillo Canyon near White Rock	09/16	RO/TOT	UF															3,850			
Potrillo Canyon near White Rock	09/16	RO/TOT	UF															4,820			
North Fork Ancho Canyon at TA-39	09/16	RO/TOT	UF															11,090			
North Fork Ancho Canyon at TA-39	09/16	RO/TOT	UF															22,320			
Ancho Canyon at TA-39	07/27	RO/TOT	UF		75.3	18.0	18.5	3.3										12,940	262.0		
Ancho Canyon at TA-39	08/04	RO/TOT	UF															14,288			
Ancho Canyon at TA-39	08/04	RO/TOT	UF															21,695			
Ancho Canyon at TA-39	08/10	RO/TOT	UF															18,570			
Ancho Canyon at TA-39	08/10	RO/TOT	UF															11,480			
Ancho Canyon near Bandelier	07/08	RO/D	F		<0.1	<0.0	4.1	<0.1											0.1		
Ancho Canyon near Bandelier	07/08	RO/TOT	UF		66.5	16.6	15.1	3.5										7,880			
Ancho Canyon near Bandelier	07/08	RO/TOT	UF															19,908			
Ancho Canyon near Bandelier	07/27	RO/TOT	UF															11,395			
Ancho Canyon near Bandelier	07/27	RO/TOT	UF															7,380			
Ancho Canyon near Bandelier	08/03	RO/TOT	UF															4,785			
Ancho Canyon near Bandelier	08/03	RO/TOT	UF															11,745			
Ancho Canyon near Bandelier	08/04	RO/TOT	UF		85.6	21.5	19.8	3.2										10,425	302.0		
Ancho Canyon near Bandelier	08/04	RO/TOT	UF															12,390			

Table 5-6. Chemical Quality of Surface Water and Runoff Samples for 1999 (mg/L[a]) (Cont.)

Station Name	Date	Matrix[b]	F/UF[c]	SiO_2	Ca	Mg	K	Na	Cl	SO_4	CO_3 Alkalinity	Total Alkalinity	F	PO_4-P	NO_3-N	CN	TDS[d]	TSS[e]	Hardness as $CaCO_3$	pH[f]	Conductance (µS/cm)
Runoff Stations (Cont.)																					
Mesa Top:																					
TA-55	08/14	RO/TOT	UF															16			
Area L	08/14	RO/TOT	UF					0.4										2			
Area G:																					
G-SWMS-1	07/29	RO/TOT	UF		71.4	18.4	11.4	5.5										6,285	254.0		
G-SWMS-1	07/29	RO/TOT	UF															14,210			
G-SWMS-2	05/24	RO/TOT	UF															6,280			
G-SWMS-2	07/14	RO/TOT	UF															3,930			
G-SWMS-2	07/29	RO/TOT	UF		49.1	7.9	4.8	5.4										3,445	155.0		
G-SWMS-2	07/29	RO/TOT	UF															4,040			
G-SWMS-3	05/28	RO/TOT	UF															15,440			
G-SWMS-3	06/17	RO/TOT	UF															25,520			
G-SWMS-3	07/15	RO/TOT	UF															22,210			
G-SWMS-3	07/15	RO/TOT	UF															30,375			
G-SWMS-3	07/29	RO/D	F		13.5	2.1	4.4	6.4											42.4		
G-SWMS-3	07/29	RO/TOT	UF		130.0	36.4	30.7	10.3										11,560	474.0		
G-SWMS-3	07/29	RO/TOT	UF															22,200			
G-SWMS-4	05/24	RO/TOT	UF															600			
G-SWMS-4	06/21	RO/TOT	UF															462			
G-SWMS-4	06/21	RO/TOT	UF															430			
G-SWMS-4	07/15	RO/TOT	UF															430			
G-SWMS-4	07/15	RO/TOT	UF															334			
G-SWMS-5	06/17	RO/TOT	UF															6,580			
G-SWMS-5	07/08	RO/TOT	UF		13.4	4.9	6.1	2.6										1,596	53.8		
G-SWMS-5	07/08	RO/TOT	UF															2,548			
G-SWMS-5	09/17	RO/TOT	UF															495			
G-SWMS-5	09/17	RO/TOT	UF															1,440			
G-SWMS-6	05/24	RO/TOT	UF															1,912			
G-SWMS-6	06/13	RO/TOT	UF															6,286			
G-SWMS-6	07/08	RO/TOT	UF		81.2	12.0	6.2	3.4										43,140	252.0		
G-SWMS-6	07/29	RO/TOT	UF															8,715			
G-SWMS-6	08/14	RO/TOT	UF															1,570			
G-SWMS-6	08/14	RO/TOT	UF															1,900			
G-SWMS-6	08/31	RO/TOT	UF															20,005			
G-SWMS-6	08/31	RO/TOT	UF															15,205			

Table 5-6. Chemical Quality of Surface Water and Runoff Samples for 1999 (mg/L[a]) (Cont.)

Station Name	Date	Matrix[b]	F/UF[c]	SiO_2	Ca	Mg	K	Na	Cl	SO_4	CO_3 Alkalinity	Total Alkalinity	F	PO_4-P	NO_3-N	CN	TDS[d]	TSS[e]	Hardness as $CaCO_3$	pH[f]	Conductance (µS/cm)
Water Quality Standards[h]																					
EPA Primary Drinking Water Standard										500			4		10	0.2					
EPA Secondary Drinking Water Standard									250	250							500			6.8–8.5	
EPA Health Advisory								20													
NMWQCC Groundwater Limit									250	600			1.6		10	0.2	1,000			6–9	

[a] Except where noted.
[b] Matrix: SW–surface water; RO–runoff; D–dissolved; TOT–total.
[c] F/UF: F–filtered; UF–unfiltered.
[d] Total dissolved solids.
[e] Total suspended solids.
[f] Standard units.
[g] Less than symbol (<) means measurement was below the specified limit of detection of the analytical method.
[h] Standards given here for comparison only; see Appendix A.

Table 5-7. Trace Metals in Surface Water and Runoff Samples for 1999 (µg/L)

Station Name	Date	Matrix[a]	F/UF[b]	Ag	Al	As	B	Ba	Be	Cd	Co	Cr	Cu	Fe	Hg
Regional Stations															
Rio Chama at Chamita	06/16	SW	F	<6[c]	79	<2	24	62	<1	<3	<6	<5	<4	44	
Rio Chama at Chamita	06/16	SW	F	<6	81	<2	23	59	<1	<3	<6	<5	<4	<30	
Rio Chama at Chamita	06/16	SW	UF												<0.10
Rio Chama at Chamita	06/16	SW	UF												<0.10
Rio Grande at Embudo	10/05	SW	F	<6	85	2	31	29	1	<3	<6	<5	6	<30	
Rio Grande at Embudo	10/05	SW	UF												<0.10
Rio Grande at Otowi Upper (bank)	08/03	SW	F	<6	<40	3	54	60	1	<3	<6	<5	<4	<30	
Rio Grande at Otowi Upper (bank)	08/03	SW	UF												<0.10
Rio Grande at Otowi (bank)	08/03	SW	F	<6	<40	2	37	63	1	<3	<6	<5	6	<30	
Rio Grande at Otowi (bank)	08/03	SW	UF												<0.10
Rio Grande at Frijoles (bank)	09/22	SW	F	<6	310	<2	36	57	1	<3	<6	<5	6	111	
Rio Grande at Frijoles (bank)	09/22	SW	F	<6	101	2	25	48	1	<3	<6	<5	6	43	
Rio Grande at Frijoles (bank)	09/22	SW	UF												<0.10
Rio Grande at Frijoles (bank)	09/22	SW	UF												<0.10
Rio Grande at Cochiti	09/23	SW	UF												<0.10
Jemez River	08/02	SW	UF												<0.10
Jemez River	08/02	SW	UF												<0.10
Pajarito Plateau															
Guaje Canyon:															
Guaje Canyon	11/16	SW	F	<6	475	<2	<10	10	<1	<3	<14	<5	<4	214	
Guaje Canyon	11/16	SW	UF												<0.10
Acid/Pueblo Canyon:															
Acid Weir	06/23	SW	F	<6	<200	<2	207	30	<1	<3	<20	<41	<4	<200	
Acid Weir	06/23	SW	F							<3					
Acid Weir	06/23	SW	UF												<0.10
Pueblo 1	06/23	SW	F	<6	433	2	33	27	<1	<3	<20	<41	<4	293	
Pueblo 1	06/23	SW	F							<3					
Pueblo 1	06/23	SW	UF												<0.10
Pueblo 3	05/20	SW	F	<6	<40	4	266	21	<1	<3	<6	6	<4	1,119	
Pueblo 3	05/20	SW	UF												<0.10
Pueblo at SR-502	08/03	SW	F	<6	<40	12	366	11	1	<3	<6	<5	4	206	
Pueblo at SR-502	08/03	SW	UF												
Pueblo at SR-502	08/04	SW	UF												<0.10
Pueblo at SR-502	12/01	SW	F	9	79	5	325	11	<1	<3	<6	<5	<6	109	
Pueblo at SR-502	12/01	SW	UF												<0.10
DP/Los Alamos Canyon:															
Los Alamos Canyon Reservoir	06/23	SW	F	<6	<200	<2	<9	17	<1	<3	<20	<41	<4	<200	

Table 5-7. Trace Metals in Surface Water and Runoff Samples for 1999 (µg/L) (Cont.)

Station Name	Date	Matrix[a]	F/UF[b]	Ag	Al	As	B	Ba	Be	Cd	Co	Cr	Cu	Fe	Hg
Pajarito Plateau (Cont.)															
DP/Los Alamos Canyon: (Cont.)															
Los Alamos Canyon Reservoir	06/23	SW	F							<3					
Los Alamos Canyon Reservoir	06/23	SW	UF												<0.10
Los Alamos at Upper Gaging Station	05/26	SW	F	<6	<40	<2	<9	39	<1	<3	<6	<5	<4	54	
Los Alamos at Upper Gaging Station	05/26	SW	UF												<0.10
Sandia Canyon:															
SCS-1	05/27	SW	UF												<0.10
SCS-2	05/19	SW	F	<6	165	4	93	29	<1	<3	<6	8	4	420	
SCS-2	05/19	SW	UF												<0.10
SCS-3	06/16	SW	F	<6	119		73	23	<1	<3	<6	9	5	166	
SCS-3	06/16	SW	UF												<0.10
Mortandad Canyon:															
Mortandad at Gaging Station 1	05/27	SW	F	<6	64	<2	126	21	<1	<3	<6	<5	7	136	
Mortandad at Gaging Station 1	05/27	SW	UF												<0.10
Mortandad at Rio Grande (A-11)	09/20	SW	F	<6	86	2	472	90	1	<3	<16	<5	23	<30	
Pajarito Canyon:															
Pajarito at Rio Grande	09/21	SW	F	<6	130	<2	28	38	1	<3	<6	<5	9	<30	
Pajarito at Rio Grande	09/21	SW	UF												<0.10
Water Canyon:															
Water Canyon at Beta	11/17	SW	F	<6	1,557	<2	14	293	<1	<3	<6	<5	<4	825	
Water Canyon at Beta	11/17	SW	UF												<0.10
Ancho Canyon:															
Ancho at Rio Grande	09/21	SW	F	<6	130	<2	9	35	<1	<3	<6	<5	6	141	
Ancho at Rio Grande	09/21	SW	UF												<0.10
Frijoles Canyon:															
Frijoles at Monument Headquarters	12/22	SW	F	<6	189	<7	<19	11	<1	<3	<6	<5	<4	161	
Frijoles at Monument Headquarters	12/22	SW	UF												<0.10
Frijoles at Rio Grande	12/22	SW	F	<6	216	<4	20	12	<1	<3	<6	<5	<5	160	
Frijoles at Rio Grande	12/22	SW	UF												<0.10
Runoff Stations															
Perimeter:															
LA Canyon near Los Alamos	04/30	RO/D	F	<6	220	2	25	47	<1	<3	<6	<5	<5	150	
LA Canyon near Los Alamos	04/30	RO/TOT	UF												<0.10
LA Canyon near Los Alamos	04/30	RO/TOT	UF	<6	130	<2	19	26	<1	<3	<6	<5	6	66	

Table 5-7. Trace Metals in Surface Water and Runoff Samples for 1999 (μg/L) (Cont.)

Station Name	Date	Matrix[a]	F/UF[b]	Ag	Al	As	B	Ba	Be	Cd	Co	Cr	Cu	Fe	Hg
Runoff Stations (Cont.)															
Perimeter: (Cont.)															
LA Canyon near Los Alamos	05/03	RO/D	F	<6	180	<2	18	27	<1	<3	<6	6	<4	71	
LA Canyon near Los Alamos	05/03	RO/TOT	UF	<6	9,100	<4	20	130	1	<3	<6	12	10	6,800	<0.10
LA Canyon near Los Alamos	08/09	RO/D	F	14	846	<2	11	53	1	<3	<6	<5	<4	335	
LA Canyon near Los Alamos	08/09	RO/TOT	UF	<6	45,659	8	30	1,194	13	4	38	24	41	23,276	0.18
LA Canyon near Los Alamos	08/10	RO/TOT	UF	<144	14,088	2	<89	503	5	<8	<20	15	73	12,801	0.50
LA Canyon near Los Alamos	08/10	RO/TOT	UF												
LA Canyon below TA-2	09/16	RO/TOT	UF	18	18,014	6	35	549	5	<3	25	15	80	15,234	0.86
DP Canyon near Los Alamos	06/23	RO/D	F	<14.4	279	<2	369	22	<1	<3	<20	11	28	329	
DP Canyon near Los Alamos	06/23	RO/TOT	UF	<14.4	28,800	8	<342	496	5	<3	<20	45	72	24,800	<0.10
DP Canyon near Los Alamos	08/14	RO/TOT	UF	11	18,664	<6	<164	268	2	<3	14	<22	32	11,654	<0.10
DP Canyon near Los Alamos	09/16	RO/TOT	UF	<15	23,527	9	56	422	4	<3	15	22	93	19,633	0.12
Sandia Canyon below Power Plant	05/28	RO/TOT	UF	<6	3,918	<2	<9	258	<1	<3	7	13	97	3,480	<0.10
Sandia Canyon below Power Plant	07/14	RO/TOT	UF												<0.10
Sandia Canyon below Wetlands	07/14	RO/TOT	UF												<0.10
Sandia Canyon below Wetlands	07/18	RO/TOT	UF												<0.10
Sandia Canyon below Wetlands	08/10	RO/TOT	UF												<0.10
Sandia Canyon near Roads & Grounds at TA-3	05/28	RO/TOT	UF	<6	2,984	<2	<9	174	<1	<3	<6	10	89	3,223	<0.10
Sandia Canyon near Roads & Grounds at TA-3	07/14	RO/TOT	UF												<0.10
Sandia Canyon near Roads & Grounds at TA-3	08/10	RO/TOT	UF	<144	13,062	3	<89	280	2	<8	<20	21	74	12,241	<0.10
Sandia Canyon near Roads & Grounds at TA-3	08/10	RO/TOT	UF												
Sandia Canyon Truck Route	09/14	RO/TOT	UF	19	6,230	5	67	401	4	<3	15	55	104	6,603	
Sandia Canyon Truck Route	09/16	RO/TOT	UF												0.88
Cañada del Buey at White Rock	06/17	RO/D	F	<6	2,527	<2	161	39	1	<3	<20	<40	4	1,289	
Cañada del Buey at White Rock	06/17	RO/D	F							<3					
Cañada del Buey at White Rock	06/17	RO/TOT	UF	<6	13,189	2	16	2,835	11	4.8	53	<40	12	625	<0.10
Cañada del Buey at White Rock	06/17	RO/TOT	UF							5					
Cañada del Buey at White Rock	07/08	RO/TOT	UF												<0.10
Cañada del Buey at White Rock	08/06	RO/TOT	UF												0.16
Cañada del Buey at White Rock	08/23	RO/TOT	UF												0.54
Cañada del Buey at White Rock	09/16	RO/TOT	UF												0.20
Pajarito Canyon above Threemile Canyon	09/16	RO/TOT	UF	17	6,900	4	37	406	3	3	15	<5	64	7,448	0.24
Pajarito Canyon above SR-4	06/17	RO/D	F	<6	727	<2	30	36	<1	<3	<20	<40	<4	472	
Pajarito Canyon above SR-4	06/17	RO/D	F							<3					
Pajarito Canyon above SR-4	06/17	RO/TOT	UF	<6	23,584	7	30	336	3	<3	<20	<40	18	15,959	<0.10
Pajarito Canyon above SR-4	06/17	RO/TOT	UF							<3					

Table 5-7. Trace Metals in Surface Water and Runoff Samples for 1999 (µg/L) (Cont.)

Station Name	Date	Matrix[a]	F/UF[b]	Ag	Al	As	B	Ba	Be	Cd	Co	Cr	Cu	Fe	Hg
Runoff Stations (Cont.)															
Perimeter: (Cont.)															
Potrillo Canyon near White Rock	08/31	RO/D	F	<6	989	<2	20	38	7	8	7	14	14	434	
Potrillo Canyon near White Rock	08/31	RO/TOT	UF	<6	19,096	2	24	915	8	<3	25	9	29	6,737	<0.10
North Fork Ancho Canyon at TA-39	09/16	RO/TOT	UF												0.24
Ancho Canyon at TA-39	07/27	RO/TOT	UF	<6	62,182	8	29	1,844	15	<4	57	26	39	26,065	0.26
Ancho Canyon at TA-39	08/04	RO/TOT	UF												<0.10
Ancho Canyon at TA-39	08/10	RO/TOT	UF												0.12
Ancho Canyon near Bandelier	07/08	RO/D	F	142	<200	<2	70	<2	<1	<3	<20	5	<4	76	
Ancho Canyon near Bandelier	07/08	RO/D	F							5					
Ancho Canyon near Bandelier	07/08	RO/TOT	UF	11	53,484	5	21	1,552	14	<3	46	26	63	26,519	<0.10
Ancho Canyon near Bandelier	07/08	RO/TOT	UF							4					
Ancho Canyon near Bandelier	07/27	RO/TOT	UF												<0.10
Ancho Canyon near Bandelier	08/03	RO/TOT	UF												<0.10
Ancho Canyon near Bandelier	08/04	RO/TOT	UF	<6	77,197	11	29	1,961	17	3	60	34	53	40,119	0.24
Mesa Top:															
TA-55	08/14	RO/TOT	UF	14	296	<2	<164	10	<1	<3	<11	<5	31	259	<0.10
Area L	08/14	RO/TOT	UF	<6	95	<2	25	31	1	<3	<6	<5	5	64	<0.10
Area G:															
G-SWMS-1	07/29	RO/TOT	UF	<6	51,069	9	29	1,043	7	<3	29	39	43	34,768	0.10
G-SWMS-2	05/24	RO/TOT	UF	<6	23,736	3	17	773	6	<3	15	10	28	10,863	<0.10
G-SWMS-2	07/29	RO/TOT	UF	<6	7,408	<2	36	461	3	<3	9	<5	18	2,848	<0.10
G-SWMS-3	05/28	RO/TOT	UF	<6	27,131	2	14	2,194	15	<3	61	11	30	2,937	<0.10
G-SWMS-3	07/15	RO/TOT	UF	<6	64,915	<7	20	3,474	25	5	97	31	62	26,918	<0.10
G-SWMS-3	07/29	RO/D	F	<6	764	2	15	42	<1	<3	<6	<5	4	456	
G-SWMS-3	07/29	RO/TOT	UF	6	139,302	16	38	2,503	19	4	74	79	91	84,676	0.64
G-SWMS-4	05/24	RO/TOT	UF	<6	11,999	5	24	317	2	<3	7	8	27	7,210	<0.10
G-SWMS-4	07/15	RO/TOT	UF	<194	<11,152	<2	<68	<637	<1	<6	<20	<5	<4	<5,196	<0.10
G-SWMS-5	06/17	RO/TOT	UF	<6	15,628	3	158	422	4	<3	<20	14	23	7,930	<0.10
G-SWMS-5	06/17	RO/TOT	UF							<3					
G-SWMS-5	07/08	RO/TOT	UF	<6	17,840	5	<317	237	3	<3	<20	21	25	12,517	
G-SWMS-5	07/08	RO/TOT	UF							<3					
G-SWMS-5	09/16	RO/TOT	UF												<0.10
G-SWMS-5	09/17	RO/TOT	UF	17	2,238	2	64	77	1	<3	<6	<5	31	1,184	
G-SWMS-6	05/24	RO/TOT	UF	<6	5,872	<2	24	323	2	<3	8	5	14	2,752	<0.10
G-SWMS-6	07/08	RO/TOT	UF	<6	18,067	<2	26	957	7	<3	<20	9	32	6,255	<0.10
G-SWMS-6	07/08	RO/TOT	UF							3					
G-SWMS-6	07/20	RO/TOT	UF												<0.10

Table 5-7. Trace Metals in Surface Water and Runoff Samples for 1999 (µg/L) (Cont.)

Station Name	Date	Matrix[a]	F/UF[b]	Ag	Al	As	B	Ba	Be	Cd	Co	Cr	Cu	Fe	Hg
Runoff Stations (Cont.)															
Area G: (Cont.)															
G-SWMS-6	07/29	RO/TOT	UF												0.10
G-SWMS-6	08/14	RO/D	F	14	322	<2	<164	27	<1	<3	<6	<5	<20	229	
G-SWMS-6	08/14	RO/TOT	UF	14	11,379	<3	<164	173	2	<3	8	12	49	8,336	<0.10
G-SWMS-6	08/31	RO/D	F	<6	226	<2	18	36	1	<3	<6	8	<13	76	
G-SWMS-6	08/31	RO/TOT	UF	<6	18,901	3	25	1,006	7	3	25	10	42	6,444	<0.10
Water Quality Standards[d]															
EPA Primary Drinking Water Standard						50		2,000	4	5		100			2
EPA Secondary Drinking Water Standard					50–200									300	
EPA Action Level													1,300		
EPA Health Advisory															
NMWQCC Livestock Watering Standard					5,000	200	5,000			50	1,000	1,000	500		10
NMWQCC Groundwater Limit				50	5,000	100	750	1,000		10	50	50	1,000	1,000	2
NMWQCC Wildlife Habitat Standard															0.012

Table 5-7. Trace Metals in Surface Water and Runoff Samples for 1999 (µg/L) (Cont.)

Station Name	Date	Matrix[a]	F/UF[b]	Mn	Mo	Ni	Pb	Sb	Se	Sn	Sr	Ti	V	Zn
Regional Stations														
Rio Chama at Chamita	06/16	SW	F	3	<10	<42	<60	<4		<60	333	<3	<7	<110
Rio Chama at Chamita	06/16	SW	F	3	<10	<42	<60	<4		<60	314	<3	<7	<110
Rio Chama at Chamita	06/16	SW	UF						<3					
Rio Chama at Chamita	06/16	SW	UF						<3					
Rio Grande at Embudo	10/05	SW	F	6	<12	<20	<60	<4		<60	196	<3	<8	<10
Rio Grande at Embudo	10/05	SW	UF						<3					
Rio Grande at Otowi Upper (bank)	08/03	SW	F	3	<11	<20	<60	<4		<86	243	<3	<7	<10
Rio Grande at Otowi Upper (bank)	08/03	SW	UF						<3					
Rio Grande at Otowi (bank)	08/03	SW	F	3	<10	<20	<60	<4		<60	248	<3	<7	<10
Rio Grande at Otowi (bank)	08/03	SW	UF						<3					
Rio Grande at Frijoles (bank)	09/22	SW	F	58	<10	<20	<60	<4		<60	229	<3	<7	<10
Rio Grande at Frijoles (bank)	09/22	SW	F	25	<10	<20	<60	<4		<60	229	<3	7	<10
Rio Grande at Frijoles (bank)	09/22	SW	UF						<3					
Rio Grande at Frijoles (bank)	09/22	SW	UF						<3					
Rio Grande at Cochiti	09/23	SW	UF						<3					
Jemez River	08/02	SW	UF						<3					
Jemez River	08/02	SW	UF						<3					
Pajarito Plateau														
Guaje Canyon:														
Guaje Canyon	11/16	SW	F	1	<10	<20	<60	<4		<60	27	<3	<7	<10
Guaje Canyon	11/16	SW	UF						<3					
Acid/Pueblo Canyon:														
Acid Weir	06/23	SW	F	<7	<10	<30	<60	<3		<60	85	<3	<20	<40
Acid Weir	06/23	SW	F					<3						
Acid Weir	06/23	SW	UF						<3					
Pueblo 1	06/23	SW	F	<7	<10	<30	<60	<3		<60	72	<3	<20	<40
Pueblo 1	06/23	SW	F					<3						
Pueblo 1	06/23	SW	UF						<3					
Pueblo 3	05/20	SW	F	869	<10	<20	<60	<4		<60	124	<3	10	15
Pueblo 3	05/20	SW	UF						<3					
Pueblo at SR-502	08/03	SW	F	162	<10	<20	<60	<4		<60	112	<3	<7	30
Pueblo at SR-502	08/03	SW	UF						<3					
Pueblo at SR-502	08/04	SW	UF						<3					
Pueblo at SR-502	12/01	SW	F	28	<10	<20	<60	<4		<60	77	<3	12	16
Pueblo at SR-502	12/01	SW	UF						<3					
DP/Los Alamos Canyon:														
Los Alamos Canyon Reservoir	06/23	SW	F	<7	<10	<30	<60	<3		<60	56	<3	<20	<40

Table 5-7. Trace Metals in Surface Water and Runoff Samples for 1999 (μg/L) (Cont.)

Station Name	Date	Matrix[a]	F/UF[b]	Mn	Mo	Ni	Pb	Sb	Se	Sn	Sr	Ti	V	Zn
Pajarito Plateau (Cont.)														
DP/Los Alamos Canyon: (Cont.)														
Los Alamos Canyon Reservoir	06/23	SW	F					<3						
Los Alamos Canyon Reservoir	06/23	SW	UF						<3					
Los Alamos at Upper Gaging Station	05/26	SW	F	10	29	<20	<60	<4		<60	87	<3	<7	<10
Los Alamos at Upper Gaging Station	05/26	SW	UF						<3					
Sandia Canyon:														
SCS-1	05/27	SW	UF						<3					
SCS-2	05/19	SW	F	5	214	<20	<60	<4		<60	106	<3	10	33
SCS-2	05/19	SW	UF						<3					
SCS-3	06/16	SW	F	4	142	<42				<60	89		8	<110
SCS-3	06/16	SW	UF						<3					
Mortandad Canyon:														
Mortandad at Gaging Station 1	05/27	SW	F	4	119	<20	<60	<4		<60	59	<3	<7	15
Mortandad at Gaging Station 1	05/27	SW	UF						<3					
Mortandad at Rio Grande (A-11)	09/20	SW	F	10	<10	<20	<60	<4		<60	135	<3	11	28
Pajarito Canyon:														
Pajarito at Rio Grande	09/21	SW	F	3	<10	<20	<60	<4		<60	113	<3	14	<10
Pajarito at Rio Grande	09/21	SW	UF						<3					
Water Canyon:														
Water Canyon at Beta	11/17	SW	F	4	<10	<20	<60	<4		<60	78	<3	<7	<10
Water Canyon at Beta	11/17	SW	UF						<3					
Ancho Canyon:														
Ancho at Rio Grande	09/21	SW	F	5	<10	<20	<60	<4		<60	69	<3	9	<10
Ancho at Rio Grande	09/21	SW	UF						<3					
Frijoles Canyon:														
Frijoles at Monument Headquarters	12/22	SW	F	7	<10	<20	<60	<4		<60	44	<3	<7	19
Frijoles at Monument Headquarters	12/22	SW	UF						<3					
Frijoles at Rio Grande	12/22	SW	F	1	<10	<20	<60	<4		<60	45	<3	<7	<10
Frijoles at Rio Grande	12/22	SW	UF						<3					
Runoff Stations														
Perimeter:														
LA Canyon near Los Alamos	04/30	RO/D	F	44	13	<20	<60	<4		<73	61	<3	<7	<33
LA Canyon near Los Alamos	04/30	RO/TOT	UF						5					
LA Canyon near Los Alamos	04/30	RO/TOT	UF	2	11	<20	<60	<4		<60	58	<3	<7	<33

Table 5-7. Trace Metals in Surface Water and Runoff Samples for 1999 (µg/L) (Cont.)

Station Name	Date	Matrix[a]	F/UF[b]	Mn	Mo	Ni	Pb	Sb	Se	Sn	Sr	Ti	V	Zn
Runoff Stations (Cont.)														
Perimeter: (Cont.)														
LA Canyon near Los Alamos	05/03	RO/D	F	2	<10	<21	<60	<4		<60	60	<3	<7	10
LA Canyon near Los Alamos	05/03	RO/TOT	UF	490	13	<20	<60	<4	3	<60	83	<3	12	91
LA Canyon near Los Alamos	08/09	RO/D	F	26	<19	<20	<60	<4		<60	79	<3	<7	11
LA Canyon near Los Alamos	08/09	RO/TOT	UF	3,837	<10	40	260	<4	4	<60	345	<3	76	304
LA Canyon near Los Alamos	08/10	RO/TOT	UF	2,060	<10	<43	170	<3	<3	<60	160	<3	37	487
LA Canyon near Los Alamos	08/10	RO/TOT	UF						<3					
LA Canyon below TA-2	09/16	RO/TOT	UF	2,166	<10	<44	150	<4	<3	<60	155	<3	39	477
DP Canyon near Los Alamos	06/23	RO/D	F	5	<10	<20	<60	<3		<60	38.2	<3	<20	<30
DP Canyon near Los Alamos	06/23	RO/TOT	UF	1,530	<10	38	230	<3	<3	<60	126	<3	50	540
DP Canyon near Los Alamos	08/14	RO/TOT	UF	499	<10	<20	<60	5	<3	<60	92	<3	25	130
DP Canyon near Los Alamos	09/16	RO/TOT	UF	1,449	<10	<72	150	<4	<3	<60	124	<3	41	600
Sandia Canyon below Power Plant	05/28	RO/TOT	UF	595	<10	<20	<60	<4	<3	<60	66	<3	18	318
Sandia Canyon below Power Plant	07/14	RO/TOT	UF						<3					
Sandia Canyon below Wetlands	07/14	RO/TOT	UF						<3					
Sandia Canyon below Wetlands	07/18	RO/TOT	UF						<3					
Sandia Canyon below Wetlands	08/10	RO/TOT	UF						<3					
Sandia Canyon near Roads & Grounds at TA-3	05/28	RO/TOT	UF	364	<10	<20	130	<4	<3	<60	42	<3	10	500
Sandia Canyon near Roads & Grounds at TA-3	07/14	RO/TOT	UF						<3					
Sandia Canyon near Roads & Grounds at TA-3	08/10	RO/TOT	UF	630	<10	29	142	<3	<3	<60	69	<3	25	643
Sandia Canyon near Roads & Grounds at TA-3	08/10	RO/TOT	UF						<3					
Sandia Canyon Truck Route	09/14	RO/TOT	UF	2,014	14	<20	69	<4		<60	118	<3	33	500
Sandia Canyon Truck Route	09/16	RO/TOT	UF						<3					
Cañada del Buey at White Rock	06/17	RO/D	F	27	<10	<30	<60	<3		<60	40	<3	<20	<40
Cañada del Buey at White Rock	06/17	RO/D	F					<1,000						
Cañada del Buey at White Rock	06/17	RO/TOT	UF	5,451	<10	60	<60	<3	<3	<60	550	<3	<20	84
Cañada del Buey at White Rock	06/17	RO/TOT	UF					<1,000	<3					
Cañada del Buey at White Rock	07/08	RO/TOT	UF						<3					
Cañada del Buey at White Rock	08/06	RO/TOT	UF						3					
Cañada del Buey at White Rock	08/23	RO/TOT	UF						<3					
Cañada del Buey at White Rock	09/16	RO/TOT	UF						<3					
Pajarito Canyon above Threemile Canyon	09/16	RO/TOT	UF	1,239	<10	36	<60	<4	<3	<60	109	<3	29	160
Pajarito Canyon above SR-4	06/17	RO/D	F	29	<10	<30	<60	<3		<60	44	<3	<20	<40
Pajarito Canyon above SR-4	06/17	RO/D	F					<1,000						
Pajarito Canyon above SR-4	06/17	RO/TOT	UF	713	<10	<30	<60	<3	<3	<60	103	<3	30	109
Pajarito Canyon above SR-4	06/17	RO/TOT	UF					2,649	<3					

Table 5-7. Trace Metals in Surface Water and Runoff Samples for 1999 (µg/L) (Cont.)

Station Name	Date	Matrix[a]	F/UF[b]	Mn	Mo	Ni	Pb	Sb	Se	Sn	Sr	Ti	V	Zn
Runoff Stations (Cont.)														
Perimeter: (Cont.)														
Potrillo Canyon near White Rock	08/31	RO/D	F	36	<18	<24	<60	<4		<60	33	<3	14	13
Potrillo Canyon near White Rock	08/31	RO/TOT	UF	2,172	<10	<20	<60	<4	4	<60	193	<3	46	70
North Fork Ancho Canyon at TA-39	09/16	RO/TOT	UF						6					
Ancho Canyon at TA-39	07/27	RO/TOT	UF	4,152	<10	68	94	<4	<3	<60	467	<3	95	221
Ancho Canyon at TA-39	08/04	RO/TOT	UF						<3					
Ancho Canyon at TA-39	08/10	RO/TOT	UF						3					
Ancho Canyon near Bandelier	07/08	RO/D	F	5	<10	<20	<60	<3		<60	2	<3	<20	<40
Ancho Canyon near Bandelier	07/08	RO/D	F											
Ancho Canyon near Bandelier	07/08	RO/TOT	UF	3,446	<10	60	130	<3	<3	<60	363	<3	77	194
Ancho Canyon near Bandelier	07/08	RO/TOT	UF											
Ancho Canyon near Bandelier	07/27	RO/TOT	UF						<3					
Ancho Canyon near Bandelier	08/03	RO/TOT	UF						<3					
Ancho Canyon near Bandelier	08/04	RO/TOT	UF	4,678	<10	70	120	<4	<3	<60	486	<3	97	250
Mesa Top:														
TA-55	08/14	RO/TOT	UF	18	<10	<20	<60	<4	<4	<60	10	<3	<7	65
Area L	08/14	RO/TOT	UF	21	<10	<20	<60	<4	<3	<60	20	<3	<7	193
Area G:														
G-SWMS-1	07/29	RO/TOT	UF	2,227	<10	57	80	<4	<3	<60	317	<3	88	288
G-SWMS-2	05/24	RO/TOT	UF	1,472	<10	<34	65	<4	<3	<60	240	<3	52	192
G-SWMS-2	07/29	RO/TOT	UF	1,048	<10	<20	<60	<4	<3	<60	187	<3	31	110
G-SWMS-3	05/28	RO/TOT	UF	5,699	<10	56	128	<4	<3	<60	560	<3	72	187
G-SWMS-3	07/15	RO/TOT	UF	8,901	<10	112	130	<3	<3	<60	784	<3	147	635
G-SWMS-3	07/29	RO/D	F	14	<10	<20	<60	<4		<60	69	<3	9	<10
G-SWMS-3	07/29	RO/TOT	UF	6,091	<10	108	140	<4	<3	<60	621	<3	168	585
G-SWMS-4	05/24	RO/TOT	UF	831	<10	<20	<60	<4	<3	<60	173	<3	25	147
G-SWMS-4	07/15	RO/TOT	UF	<2,138	<10	<212	<60	<3	<3	<60	<136	<3	<20	<133
G-SWMS-5	06/17	RO/TOT	UF	1,002	<10	<20	<60	<3	<3	<60	103	<3	27	134
G-SWMS-5	06/17	RO/TOT	UF											
G-SWMS-5	07/08	RO/TOT	UF	518	<10	24	<60	<3		<60	70	<3	23	102
G-SWMS-5	07/08	RO/TOT	UF											
G-SWMS-5	09/16	RO/TOT	UF						<3					
G-SWMS-5	09/17	RO/TOT	UF	183	<10	<20	<60	<4		<60	29	<3	<7	47
G-SWMS-6	05/24	RO/TOT	UF	610	<10	<20	<60	<4	<3	<60	137	<3	25	111
G-SWMS-6	07/08	RO/TOT	UF	2,079	<10	44	<60	<3	<3	<60	319	<3	54	243
G-SWMS-6	07/08	RO/TOT	UF											
G-SWMS-6	07/20	RO/TOT	UF						<3					

Table 5-7. Trace Metals in Surface Water and Runoff Samples for 1999 (μg/L) (Cont.)

Station Name	Date	Matrix[a]	F/UF[b]	Mn	Mo	Ni	Pb	Sb	Se	Sn	Sr	Ti	V	Zn
Runoff Stations (Cont.)														
Area G: (Cont.)														
G-SWMS-6	07/29	RO/TOT	UF						<3					
G-SWMS-6	08/14	RO/D	F	6	<10	<20	<60	7		<60	42	<3	7	10
G-SWMS-6	08/14	RO/TOT	UF	545	<10	<81	68	<4	<3	<60	64	<3	17	204
G-SWMS-6	08/31	RO/D	F	13	<10	<20	<60	<4		<60	54	<3	8	10
G-SWMS-6	08/31	RO/TOT	UF	2,537	<14	<30	<60	<4	5	<60	279	<3	57	331
Water Quality Standards[d]														
EPA Primary Drinking Water Standard						100		6	50			2		
EPA Secondary Drinking Water Standard				50										5,000
EPA Action Level							15							
EPA Health Advisory											25,000–90,000		80–110	
NMWQCC Livestock Watering Standard							100		50				100	25,000
NMWQCC Groundwater Limit				200	1,000	200	50		50					10,000
NMWQCC Wildlife Habitat Standard									2					

[a] Matrix: SW–surface water; RO–runoff; D–dissolved; TOT–total.
[b] F/UF: F–filtered; UF–unfiltered.
[c] Less than symbol (<) means measurement was below the specified limit of detection of the analytical method.
[d] Standards given here for comparison only; see Appendix A. Note that New Mexico Livestock Watering and Groundwater limits are based on dissolved concentrations, whereas many of these analyses are of unfiltered samples; thus, concentrations may include suspended sediment quantities.

Table 5-8. Number of Samples Collected for Each Suite of Organic Compounds in Surface Water and Runoff Samples in 1999

			Organic Suite[a]			
Station Name	**Date**	**Matrix[b]**	**HE**	**PCB**	**Semivolatile**	**Volatile**
Ancho Canyon near Bandelier	06/18	RO/TOT	1			
Ancho Canyon near Bandelier	07/08	RO/TOT	1			
Area L	08/14	RO/TOT		1	1	
Cañada Del Buey at WR	06/17	RO/TOT		1	1	
Cañada Del Buey at WR	07/08	RO/TOT	1			
Cañada Del Buey at WR	09/16	RO/TOT	1	1	1	
DP Canyon near Los Alamos	06/23	RO/TOT	1		1	
DP Canyon near Los Alamos	08/14	RO/TOT		1	1	
DP Canyon near Los Alamos	09/16	RO/TOT		1	1	
G-SWMS-1	07/29	RO/TOT	1	1	1	
G-SWMS-3	07/15	RO/TOT	1	1	1	
G-SWMS-3	07/29	RO/TOT	1	1	1	
G-SWMS-4	07/15	RO/TOT	1	1	1	
G-SWMS-5	09/17	RO/TOT	1			
G-SWMS-6	06/14	RO/TOT		1	1	
G-SWMS-6	07/29	RO/TOT		1	1	
G-SWMS-6	08/14	RO/TOT		1	1	
G-SWMS-6	08/31	RO/TOT		1	1	
LA Canyon below TA-2	09/16	RO/TOT		1	1	
LA Canyon near LA	08/09	RO/TOT		1	1	
LA Canyon near LA	08/10	RO/TOT		1	1	
Pajarito Canyon above SR-4	06/17	RO/TOT	1	1	1	
Pajarito Canyon above Threemile Canyon	09/16	RO/TOT		1	1	
Potrillo Canyon near White Rock	08/31	RO/TOT		1	1	
Potrillo Canyon near White Rock	09/16	RO/TOT	1			
Sandia Canyon below Power Plant	06/02	RO/TOT		1		
Sandia Canyon below Power Plant	07/14	RO/TOT		1		
Sandia Canyon below Wetlands	07/12	RO/TOT		1		
Sandia Canyon below Wetlands	07/18	RO/TOT		1		
Sandia Canyon below Wetlands	08/10	RO/TOT		1		
Sandia Canyon near Roads & Grounds at TA-3	07/14	RO/TOT		1		
Sandia Canyon near Roads & Grounds at TA-3	08/10	RO/TOT		1	1	
Sandia Canyon Truck Route	09/14	RO/TOT		1		
TA-55	08/14	RO/TOT		1	1	
Acid Weir	06/23	SW		1	1	1
Ancho at Rio Grande	09/22	SW		1	1	1
Frijoles at Monument HQ	12/21	SW	1	1	1	1
Frijoles at Rio Grande	12/21	SW	1		1	1
Guaje Canyon	11/16	SW		1	1	1
Los Alamos Canyon Reservoir	06/23	SW		1	1	1
Pajarito at Rio Grande	09/21	SW		1	1	1
Pueblo 1	06/23	SW		1	1	1
Pueblo 3	05/20	SW		1	1	1
Pueblo at SR-502	12/01	SW				1
SCS-2	05/19	SW		1	1	1
Water Canyon at Beta	11/17	SW		1	1	1

[a] High explosives, polychlorinated biphenyls, semivolatiles, and volatiles.
[b] Matrix: SW–surface water; RO–runoff; D–dissolved; TOT–total.

Table 5-9. Station Descriptions for Special Sediment Sampling during 1999

Station Name	Description	Sample Date
White Rock, Cañada del Buey		
Site #1 Bonnie View South bank 1	0–34 cm	10/28
Site #1 Bonnie View South bank 2	34–90 cm	10/28
Site #1 Bonnie View Stream Channel 3	0–2 cm (wdth intgrt)	10/28
Site #2 Rover South bank 1	0–14 cm	10/28
Site #2 Rover South bank 2	14–35 cm	10/28
Site #2 Rover South bank 3	35–45 cm	10/28
Site #2 Rover Stream Channel 4	0–2 cm (wdth intgrt)	10/28
Site #3 Lejano South bank 1	5–29 cm	10/28
Site #3 Lejano South bank 2	29–65 cm	10/28
Site #3 Lejano Stream Channel 3	0–2 cm (wdth intgrt)	10/28
Site #4 Meadow Lane South bank 1	0–45 cm	10/28
Site #4 Meadow Lane South bank 2	45–74 cm	10/28
Site #4 Meadow Lane South bank 3	74–95 cm	10/28
Site #4 Meadow Lane Stream Channel 5	0–2 cm (wdth intgrt)	10/28
Site #5 Overlook Park South bank 1	0–17 cm	10/28
Site #5 Overlook Park South bank 2	17–66 cm	10/28
Site #5 Overlook Park South bank 3	66–120 cm	10/28
Site #5 Overlook Park South bank 4	120–166 cm	10/28
Site #5 Overlook Park Stream Channel 5	0–2 cm (wdth intgrt)	10/28
Site #5 Overlook Park Stream Channel Dup 6	0–2 cm (wdth intgrt)	10/28
Special EPA Sampling		
Ancho Canyon 1	0–5 cm	12/16
Ancho Canyon 2	0–17 cm	12/16
Ancho Canyon 3	6–16 cm	12/16
Ancho Canyon 4	0–7 cm	12/16
Ancho Canyon 5	10–24 cm	12/16
Bayo Canyon 1	0–14 cm	12/13
Bayo Canyon 2	14–27 cm	12/13
Bayo Canyon 3	10–22 cm	12/13
Bayo Canyon 4	4–11 cm	12/13
Cañada del Buey 1	10–17 cm	12/15
Cañada del Buey 2	5–15 cm	12/15
Cañada del Buey 3	1–13 cm	12/16
Cañada del Buey 4	0–2 cm	12/15
Cañada del Buey 4	0–2 cm	12/15
Cañada del Buey 5A	18–26 cm	12/15
Cañada del Buey 5B	30–39 cm	12/16
Cañada del Buey 6	0–7.5 cm	12/15
Cañada del Buey 7	0–7 cm	12/15
Cañada del Buey 8	20–33 cm	12/15
Mortandad Canyon 1	0–5 cm	12/14
Mortandad Canyon 2	0–8 cm	12/14
Mortandad Canyon 3	15–24 cm	12/14
Mortandad Canyon 4	0–5 cm	12/14
Mortandad Canyon 5A	0–13 cm	12/14
Mortandad Canyon 5B	22–30 cm	12/14

Table 5-9. Station Descriptions for Special Sediment Sampling during 1999 (Cont.)

Station Name	Description	Sample Date
Special EPA Sampling		
Pajarito Canyon 1	0–17 cm	12/16
Pajarito Canyon 2	0–24 cm	12/16
Pajarito Canyon 3	0–21 cm	12/16
Pajarito Canyon 4	0–5 cm	12/16
Sandia Canyon 1	0–17 cm	12/13
Sandia Canyon 2	0–3 cm	12/13
Sandia Canyon 3	8–19 cm	12/13
Sandia Canyon 4	2–12 cm	12/13
Sandia Canyon 5	0–18 cm	12/13
Sandia Canyon 6	0–12 cm	12/13

Table 5-10. Radiochemical Analysis of Sediments for 1999 (pCi/g)[a,b]

Station Name	Date	Code[c]	^{3}H (pCi/L)		^{137}Cs		U (mg/kg)		^{238}Pu		$^{239,240}Pu$		^{241}Am		Gross Alpha		Gross Beta		Gross Gamma	
Regional Stations																				
Rio Chama at Chamita	05/04	1	90	600	0.05	0.01	0.90	0.20	0.0028	0.0018	0.0025	0.0014			3.14	1.47	2.97	1.53	0.4	0.2
Rio Grande at Embudo	05/04	1	140	600	0.13	0.02	1.20	0.20	–0.0010	0.0003	0.0019	0.0029			3.91	1.80	3.80	1.90	1.2	0.2
Rio Grande at Otowi (bank)	08/03	1	140	610	0.02	0.03	0.86	0.08	0.0007	0.0007	0.0001	0.0009	0.0192	0.0028	1.67	0.69	1.09	0.55	1.9	0.2
Rio Grande at Otowi Upper (bank)	08/03	1	80	610	0.01	0.03	1.70	0.10	0.0029	0.0011	0.0012	0.0008	0.0242	0.0038	3.87	1.52	2.86	1.27	3.0	0.3
Rio Grande at Frijoles (bank)	12/21	1	–290	670	0.06	0.03	1.02	0.05											2.1	0.2
Rio Grande at Frijoles (wdth intgrt)																				
Rio Grande at Cochiti Spillway	09/23	1	–40	740	0.12	0.02	1.11	0.07	0.0016	0.0009	0.0046	0.0014			3.97	1.54	2.33	1.13	2.3	0.2
Rio Grande at Bernalillo	05/04	1	190	600	0.14	0.02	1.30	0.20	0.0100	0.0029	0.0088	0.0028			3.35	1.87	2.12	1.79	2.3	0.2
Jemez River	08/02	1	130	610	0.05	0.04	0.50	0.04	0.0063	0.0012	0.0030	0.0008	0.0022	0.0008	0.91	0.69	1.00	0.73	2.6	0.3
Reservoirs on Rio Chama (New Mexico)																				
Heron Upper	08/31	1	–190	600	0.38	0.05	1.20	0.20							3.99	1.20	3.66	1.21	2.6	0.3
Heron Middle	08/31	1	130	630	0.27	0.04	1.20	0.10							4.00	1.20	2.82	1.04	4.8	0.5
Heron Lower	08/31	1	740	670	0.23	0.04	1.10	0.20							6.85	1.78	4.23	1.32	5.5	0.5
El Vado Upper	09/02	1					3.10	0.40												
El Vado Upper	08/31	1	600	660	0.19	0.03									5.32	1.47	3.15	1.11	2.8	0.3
El Vado Middle	08/31	1	190	630	0.18	0.04	1.80	0.10							6.25	1.66	4.18	1.31	3.3	0.3
El Vado Lower	08/31	1	80	620	0.23	0.03	1.40	0.20							4.83	1.37	3.43	1.17	3.1	0.3
Abiquiu Upper	08/30	1					2.40	0.30												
Abiquiu Middle	10/12	1	3,090	920	0.40	0.05	2.10	0.50							12.60	3.71	7.47	2.62	3.2	0.3
Abiquiu Middle	10/12	D	4,440	980	0.13	0.03									7.12	2.23	5.75	1.95	2.4	0.2
Abiquiu Lower	10/12	D	6,500	1,100	0.12	0.03									6.11	2.02	4.47	1.66	1.8	0.2
Abiquiu Lower	10/12	1	3,320	930	0.11	0.03	1.90	0.20							4.94	1.76	3.42	1.41	1.9	0.2
Reservoirs on Rio Grande (Colorado)																				
Rio Grande Upper	09/02	1	–150	600	0.67	0.08	3.30	0.30							11.00	2.58	7.90	2.03	4.5	0.5
Rio Grande Middle	09/02	1	50	620	0.37	0.05	1.70	0.20							10.40	2.47	6.33	1.73	4.1	0.4
Rio Grande Lower	09/02	2	–190	600	0.53	0.07	1.70	0.20							10.10	2.41	6.78	1.82	4.3	0.4
Rio Grande Lower	09/02	1	210	630	0.57	0.08	2.90	0.40							10.50	2.48	7.33	1.92	4.0	0.4
Reservoirs on Rio Grande (New Mexico)																				
Cochiti Upper	10/13	1	–250	730	0.16	0.05	3.90	0.20							6.67	2.43	5.27	2.11	2.4	0.2
Cochiti Middle	10/13	1	980	800	0.30	0.05	2.90	0.30							8.88	3.29	8.88	3.31	3.3	0.3
Cochiti Middle	10/13	2	130	750	0.26	0.05	2.30	0.20							9.07	2.96	6.70	2.44	3.3	0.3
Cochiti Lower	10/13	1	100	750	0.30	0.05	3.70	0.30							10.80	3.72	10.50	3.68	3.4	0.3
Other Reservoirs (New Mexico)																				
Guaje Reservoir	11/16	1	1,480	700	0.51	0.10	10.90	0.60							22.30	4.73	14.40	3.26	4.1	0.3
Guaje Reservoir	11/16	D			0.56	0.07									23.00	4.87	13.30	3.05	3.7	0.4

Table 5-10. Radiochemical Analysis of Sediments for 1999 (pCi/g)[a,b] (Cont.)

Station Name	Date	Code[c]	^{3}H (pCi/L)		^{137}Cs		U (mg/kg)		^{238}Pu		^{239,240}Pu		^{241}Am		Gross Alpha		Gross Beta		Gross Gamma	
Pajarito Plateau Stations																				
Guaje Canyon:																				
Guaje at SR-502	12/01	2	240	710	0.08	0.04	0.22	0.02											2.9	0.3
Guaje at SR-502	12/01	1	–120	690	0.05	0.02	0.29	0.02											3.0	0.3
Bayo Canyon:																				
Bayo at SR-502	08/03	1	150	610	0.06	0.01	0.32	0.03	0.0028	0.0010	0.0024	0.0013	0.0082	0.0021	3.02	1.00	1.84	0.74	2.7	0.3
Acid/Pueblo Canyons:																				
Acid Weir	04/27	1	190	630	0.20	0.04	0.58	0.02	0.0290	0.0023	6.6021	0.1717	0.4200	0.0140	16.00	3.54	4.47	1.37	2.2	0.2
Pueblo 1	04/27	1	40	620	0.02	0.02	0.25	0.02	–0.0002	0.0002	0.0049	0.0011	0.0020	0.0007	2.97	0.98	2.86	1.05	2.3	0.2
Pueblo 2	05/24	D					0.20	0.03												
Pueblo 2	05/24	1	480	630	0.04	0.01			0.0005	0.0005	0.9672	0.0313			2.96	0.99	1.43	0.68	2.5	0.2
Hamilton Bend Spring	05/24	D					0.35	0.04												
Hamilton Bend Spring	05/24	1	290	620	0.04	0.01			0.0038	0.0013	0.5096	0.0209			2.87	0.97	2.19	0.85	3.2	0.3
Pueblo 3	05/24	2	260	620	0.00	0.09			0.0012	0.0006	0.1796	0.0083			1.40	0.62	1.67	0.73	2.8	0.3
Pueblo 3	05/24	D					0.27	0.03												
Pueblo 3	05/24	1	500	640	0.01	0.06			0.0038	0.0011	0.2046	0.0092			1.92	0.75	1.72	0.74	2.9	0.3
Pueblo at SR-502	08/04	1	–20	600	0.03	0.02	0.59	0.05	0.0031	0.0010	1.0782	0.0336	0.0353	0.0042	5.33	1.85	5.15	1.82	3.4	0.3
DP/Los Alamos Canyons:																				
Los Alamos at Bridge	04/27	2	70	620	0.09	0.02	0.77	0.03	0.0010	0.0006	0.0025	0.0007	0.0013	0.0005	4.87	1.38	3.55	1.19	2.3	0.2
Los Alamos at Bridge	04/27	1	100	620	0.05	0.03	0.35	0.02	0.0016	0.0007	0.0027	0.0009	0.0021	0.0007	3.78	1.15	2.93	1.07	2.6	0.3
Los Alamos at LAO-1	04/23	1	30	590	0.10	0.01	0.90	0.40	0.0141	0.0019	0.1384	0.0065	0.0063	0.0014	4.09	1.23	2.89	1.00	2.3	0.2
DPS-1	04/23	1	1,830	720	0.31	0.04	0.60	0.30	0.0105	0.0018	0.0246	0.0027	0.1087	0.0079	2.49	0.87	2.53	0.90	2.0	0.2
DPS-4	04/27	1	560	660	1.59	0.18	0.33	0.02	0.0277	0.0036	0.0989	0.0071	0.2562	0.0098	3.77	1.15	6.17	1.70	4.6	0.5
Los Alamos at Upper GS	04/23	1	540	630	0.08	0.01	0.40	0.20	0.0006	0.0005	0.2182	0.0087	0.0051	0.0012	2.30	0.84	1.41	0.67	1.9	0.2
Los Alamos at LAO-3	04/23	1	190	600	0.69	0.08	0.60	0.40	0.0022	0.0009	0.3185	0.0131	0.1011	0.0061	2.67	0.93	3.95	1.22	1.5	0.2
Los Alamos at LAO-4.5	04/23	1	–80	580	1.26	0.14	0.50	0.40	0.0233	0.0021	0.1088	0.0052	0.1488	0.0086	2.63	0.92	3.12	1.05	1.4	0.2
Los Alamos at SR-4	08/03	1	240	620	0.05	0.04	0.66	0.03	0.0051	0.0015	0.0344	0.0032	0.0516	0.0052	2.99	1.00	2.99	1.00	3.3	0.3
Los Alamos at Totavi	08/03	1	150	610	0.02	0.03	0.45	0.02	0.0011	0.0010	0.0074	0.0019	0.0005	0.0007	3.78	1.17	2.56	0.90	2.5	0.3
Los Alamos at Otowi	08/03	1	460	640	0.08	0.04	0.48	0.04	0.0016	0.0010	0.0430	0.0040	0.0245	0.0042	5.99	1.62	3.68	1.15	3.0	0.3
Sandia Canyon:																				
Sandia at SR-4	08/03	1	270	620	0.05	0.04	0.11	0.02	0.0023	0.0009	0.0003	0.0005	0.0096	0.0026	2.01	0.78	1.86	0.74	2.5	0.3
Mortandad Canyon:																				
Mortandad near CMR Building	04/29	1	50	610	0.00	0.03	0.27	0.01	0.0324	0.0045	0.0201	0.0036			4.52	1.32	3.30	1.07	1.9	0.2
Mortandad West of GS-1	04/29	1	530	640	0.24	0.04	1.99	0.03	0.0159	0.0031	0.0409	0.0050			5.75	1.57	4.78	1.38	2.9	0.3
Mortandad at GS-1	04/29	1	4,870	900	16.50	1.80	0.38	0.01	12.1292	0.3870	10.4218	0.3333			82.50	16.90	20.70	5.17	16.2	1.6
Mortandad at MCO-5	04/29	1	2,260	750	18.00	2.00	0.23	0.01	3.2056	0.1131	8.0920	0.2771			23.30	4.93	17.10	0.45	16.5	1.6

Table 5-10. Radiochemical Analysis of Sediments for 1999 (pCi/g)[a,b] (Cont.)

Station Name	Date	Code[c]	^{3}H (pCi/L)		^{137}Cs		U (mg/kg)		^{238}Pu		^{239,240}Pu		^{241}Am		Gross Alpha		Gross Beta		Gross Gamma	
Pajarito Plateau Stations (Cont.)																				
Mortandad Canyon: (Cont.)																				
Mortandad at MCO-5	04/29	2	3,500	830	21.90	2.40	0.53	0.01	31.2870	1.1610	78.3171	2.8163			9.22	2.25	7.61	1.94	20.4	2.0
Mortandad at MCO-7	04/29	1	1,080	680	4.21	0.47	0.35	0.02	0.6212	0.0302	1.9244	0.0790			8.58	2.13	6.77	1.78	4.8	0.5
Mortandad at MCO-9	04/29	1	370	630	0.38	0.05	1.13	0.01	0.0146	0.0030	0.0497	0.0054			4.94	1.41	4.50	1.32	5.3	0.5
Mortandad at MCO-13 (A-5)	08/05	2	180	620	0.22	0.05	1.30	0.20	0.0044	0.0015	0.0211	0.0025	0.0088	0.0022	7.60	1.93	5.21	1.46	3.1	0.3
Mortandad at MCO-13 (A-5)	08/05	1	230	620	0.34	0.05	0.55	0.07	0.0009	0.0006	0.0164	0.0023	0.0203	0.0057	6.06	1.63	4.86	1.39	3.3	0.3
Mortandad A-6	08/05	1	440	630	0.39	0.07	0.81	0.03	0.0008	0.0006	0.0176	0.0024	0.0240	0.0043	12.10	2.80	7.91	2.00	3.7	0.4
Mortandad A-7	08/05	1	210	620	0.17	0.05	0.69	0.08	0.0030	0.0010	0.0131	0.0020	0.0092	0.0018	4.92	1.40	4.45	1.31	3.1	0.3
Mortandad at SR-4 (A-9)	08/05	1	140	610	0.15	0.05	1.40	0.30	0.0001	0.0004	0.0064	0.0014	0.0038	0.0014	4.32	1.28	3.74	1.16	3.8	0.4
Mortandad at SR-4 (A-9)	08/05	2	260	620	0.20	0.05	1.30	0.20	0.0051	0.0015	0.0049	0.0013	0.0352	0.0039	9.54	2.31	7.30	1.88	4.0	0.4
Mortandad at Rio Grande (A-11)	09/20	1	60	750	0.02	0.02	0.43	0.02	0.0028	0.0012	0.0043	0.0015			3.04	1.01	3.27	1.06	2.8	0.3
Cañada del Buey:																				
Cañada del Buey at SR-4	05/24	D					0.28	0.05												
Cañada del Buey at SR-4	05/24	1	220	620	0.04	0.01			0.0015	0.0008	0.0066	0.0014			1.77	0.71	1.50	0.69	2.1	0.2
CDB_01	07/20	1	130	610	0.11	0.02	0.58	0.06	0.0029	0.0009	0.0087	0.0014	0.0052	0.0096	6.00	1.50	4.81	0.90	3.4	0.3
CDB_02	07/20	1	60	610	0.22	0.03	0.98	0.03	0.0013	0.0008	0.0016	0.0008	–0.0046	0.0091	5.90	1.40	4.19	0.82	3.2	0.3
CDB_02	07/20	2	–70	600	0.20	0.02	0.81	0.06	0.0039	0.0013	0.0112	0.0019	–0.0066	0.0088	8.40	1.90	4.14	0.82	3.3	0.3
CDB_02	07/20	3	–40	600	0.19	0.03	0.78	0.05	0.0013	0.0007	0.0100	0.0016	–0.0070	0.0088	5.20	1.40	4.21	0.83	3.1	0.3
TA-54 Area G:																				
G-0	04/14	D	890	690	0.15	0.03	3.13	0.31	0.0237	0.0030	0.1255	0.0087	0.0916	0.0061	6.92	1.80	4.38	1.29	3.7	0.4
G-0	04/14	2					1.10	0.10												
G-0	04/14	1					1.50	0.10												
G-1	04/14	1	350	650	0.22	0.06	0.68	0.04	0.0245	0.0030	0.0105	0.0020	0.0022	0.0009	2.01	0.78	1.87	0.76	2.7	0.3
G-2	04/14	1	1,020	700	0.06	0.01	0.94	0.07	0.0019	0.0009	0.0077	0.0016	0.0016	0.0007	3.19	1.03	2.50	0.89	2.5	0.3
G-3	04/14	1	590	670	0.19	0.03	1.46	0.04	0.0030	0.0010	0.0162	0.0022	0.0055	0.0013	6.48	1.72	4.85	1.40	3.3	0.3
G-4 R-1	04/14	1	4,100	880	0.18	0.03	1.35	0.09	0.0066	0.0015	0.0469	0.0043	0.0093	0.0020	3.00	1.00	2.39	0.88	2.9	0.3
G-4 R-2	04/14	1	2,560	790	0.32	0.04	0.34	0.02	0.0041	0.0015	0.0662	0.0052	0.0160	0.0024	6.34	1.69	4.76	1.37	3.6	0.4
G-5	04/14	1	1,210	710	0.08	0.01	1.24	0.07	0.0132	0.0029	0.0570	0.0056	0.0311	0.0034	5.31	1.48	3.89	1.20	3.0	0.3
G-6 R	04/14	1	530	660	0.03	0.01	0.48	0.02	0.0097	0.0024	0.2446	0.0144	0.0526	0.0069	3.38	1.09	2.22	0.84	2.8	0.3
G-7	04/15	1	3,010	790	0.30	0.04	0.49	0.02	0.1472	0.0082	0.2612	0.0121	0.0926	0.0073	6.66	1.75	5.99	1.63	3.6	0.4
G-7	04/15	2	3,100	800	0.31	0.04	1.17	0.05	0.1624	0.0088	0.2189	0.0108	0.0428	0.0050	6.03	1.62	4.18	1.27	2.7	0.3
G-8	04/14	1	300	650	0.10	0.02	0.99	0.05	0.0069	0.0018	0.0101	0.0022	0.0111	0.0024	1.90	0.75	1.66	0.71	3.3	0.3
G-9	04/14	1	400	660	0.11	0.02	4.30	0.20	0.3702	0.0161	0.4851	0.0199	0.0185	0.0028	5.59	1.54	4.64	1.35	2.6	0.3
G3_01	07/20	3													3.90	1.00	2.88	0.69		
G3_01	07/20	2	260	620	0.07	0.01	0.66	0.04	0.0124	0.0022	0.0357	0.0038			3.99	1.00	3.21	0.70	4.0	0.4
G3_01	07/20	1	190	620	0.03	0.01	0.90	0.10	0.0045	0.0014	0.0519	0.0047			2.48	0.71	1.92	0.57	2.7	0.3
G3_02	07/20	2													2.17	0.65	1.79	0.58		
G3_02	07/20	1	1,400	700	0.02	0.01	0.58	0.05	0.0106	0.0022	0.0238	0.0032			5.20	1.20	2.73	0.69	3.4	0.3
TWISP Dome at Silt Fence	07/29	1	6,800	1,000	0.07	0.02	0.93	0.05							6.98	1.80	3.45	1.17	4.9	0.5

Table 5-10. Radiochemical Analysis of Sediments for 1999 (pCi/g)[a,b] (Cont.)

Station Name	Date	Code[c]	^{3}H (pCi/L)		^{137}Cs		U (mg/kg)		^{238}Pu		$^{239,240}Pu$		^{241}Am		Gross Alpha		Gross Beta		Gross Gamma	
Pajarito Plateau Stations (Cont.)																				
Pajarito Canyon:																				
Twomile at SR-501	03/31	1	390	640	0.13	0.02	1.36	0.14	0.0014	0.0010	0.0050	0.0015	0.0143	0.0080	5.24	1.45	4.13	1.25	2.3	0.2
Twomile at SR-501	03/31	D					0.43	0.03												
Pajarito at SR-501	03/31	1	300	640	0.05	0.01	1.00	0.10	0.0010	0.0006	0.0040	0.0011	0.0059	0.0075	2.12	0.80	1.60	0.71	2.2	0.2
Pajarito at SR-501	03/31	D					0.41	0.02												
Pajarito at SR-4	04/15	1	270	610	0.58	0.06	2.00	0.10	0.4241	0.0183	0.0701	0.0055	0.0108	0.0037	3.28	1.06	2.73	0.97	5.0	0.5
Potrillo Canyon:																				
Potrillo at SR-4	05/24	D					0.35	0.03												
Potrillo at SR-4	03/31	1	880	680	0.09	0.01	1.62	0.20	0.0003	0.0014	0.0017	0.0011	0.0091	0.0081	3.52	1.11	3.08	1.03	2.6	0.3
Fence Canyon:																				
Fence at SR-4	04/15	1	570	630	0.52	0.06	0.43	0.03	0.0010	0.0013	0.0273	0.0035	0.0084	0.0018	8.73	2.15	6.35	1.70	5.8	0.6
Cañon de Valle:																				
Cañon de Valle at SR-501	03/31	D	590	650	0.58	0.06	2.19	0.22	0.0021	0.0014	0.0387	0.0045	0.0096	0.0077	6.70	1.76	5.97	1.63	3.6	0.4
Water Canyon:																				
Water at SR-501	03/31	D	150	620	0.08	0.01	1.36	0.14	0.0003	0.0016	0.0061	0.0018	–0.0088	0.0067	2.01	0.80	2.54	0.92	2.4	0.2
Water at SR-4	03/31	1	690	660	0.08	0.01	1.44	0.14	–0.0011	0.0019	–0.0017	0.0015	0.0028	0.0086	4.35	1.28	3.71	1.17	4.2	0.4
Water at SR-4	03/31	D					1.20	0.30												
Indio Canyon:																				
Indio at SR-4	03/31	1	1,160	690	0.10	0.02	1.30	0.13	0.0021	0.0011	0.0045	0.0016	–0.0037	0.0069	2.67	0.92	2.59	0.93	5.1	0.5
Indio at SR-4	03/31	D					1.01	0.09												
Ancho Canyon:																				
Ancho at SR-4	03/31	2	3,040	810	0.08	0.01	1.65	0.17	0.0003	0.0006	0.0039	0.0013	0.0098	0.0006	2.63	0.90	2.43	0.90	3.3	0.3
Ancho at SR-4	03/31	D					0.90	0.06												
Ancho at SR-4	03/31	1	3,870	860	0.13	0.02	1.71	0.17	–0.0015	0.0019	0.0081	0.0023	0.0073	0.0074	2.59	0.90	2.48	0.90	4.1	0.4
Above Ancho Spring	09/21	1	150	750	0.30	0.06	0.89	0.05	0.0041	0.0014	0.0113	0.0023			4.84	1.38	3.68	1.15	3.4	0.3
Ancho at Rio Grande	09/21	1	–60	740	0.29	0.07	0.78	0.03	0.0003	0.0005	0.0092	0.0016			4.28	1.27	3.74	1.16	3.7	0.4
Chaquehui Canyon:																				
Chaquehui at Rio Grande	09/22	2	130	750	0.65	0.09	1.52	0.08	0.0026	0.0014	0.0456	0.0052			7.19	1.85	5.14	1.45	3.9	0.4
Chaquehui at Rio Grande	09/22	1	110	750	0.69	0.11	1.85	0.08	0.0033	0.0014	0.0272	0.0035			6.92	1.80	4.64	1.35	3.7	0.4
Chaquehui at Rio Grande	09/22	2	130	750	0.65	0.09	1.52	0.08	0.0026	0.0014	0.0456	0.0052			7.19	1.85	5.14	1.45	3.9	0.4
Chaquehui at Rio Grande	09/22	1	110	750	0.69	0.11	1.85	0.08	0.0033	0.0014	0.0272	0.0035			6.92	1.80	4.64	1.35	3.7	0.4

Table 5-10. Radiochemical Analysis of Sediments for 1999 (pCi/g)[a,b] (Cont.)

Station Name	Date	Code[c]	^{3}H (pCi/L)		^{137}Cs		U (mg/kg)		^{238}Pu		^{239,240}Pu		^{241}Am		Gross Alpha		Gross Beta		Gross Gamma	
Pajarito Plateau Stations (Cont.)																				
TA-49, Area AB:																				
AB-1	04/21	1	350	630	0.37	0.05	1.80	0.20	0.0046	0.0016	0.0181	0.0024	0.0152	0.0074	10.50	2.50	6.11	1.65	3.4	0.3
AB-2	04/21	1	590	650	0.17	0.04	1.80	0.20	–0.0008	0.0009	0.0491	0.0063	0.0098	0.0032	8.07	2.02	4.79	1.39	3.3	0.3
AB-3	04/15	1	230	610	0.42	0.05	1.46	0.05	0.0192	0.0028	1.0830	0.0380	0.2536	0.0136	8.45	2.10	6.38	1.71	9.2	0.9
AB-4	04/21	1	160	610	0.17	0.03	1.08	0.06	0.0004	0.0007	0.0082	0.0014	0.0145	0.0075	8.82	2.17	5.45	1.53	3.0	0.3
AB-4A	04/21	1	300	620	0.41	0.06	1.60	0.10	–0.0002	0.0007	0.0172	0.0026	0.0138	0.0075	10.40	2.47	5.89	1.61	3.2	0.3
AB-5	04/21	1	590	650	0.90	0.11	1.45	0.09	0.0018	0.0012	0.0268	0.0026	0.0206	0.0078	7.12	1.84	5.17	1.47	3.4	0.3
AB-6	04/21	1	330	630	0.20	0.04	0.84	0.04	0.0037	0.0016	0.0106	0.0023	0.0030	0.0016	5.01	1.42	3.43	1.11	2.9	0.3
AB-7	04/21	1	470	640	0.53	0.07	4.80	0.20	0.0008	0.0008	0.0103	0.0018	0.0072	0.0072	5.45	1.51	5.36	1.51	3.2	0.3
AB-8	04/21	1	190	620	0.11	0.04	1.77	0.09	0.0007	0.0005	0.0042	0.0010	0.0139	0.0075	6.05	1.63	3.76	1.18	2.8	0.3
AB-9	04/21	2	420	630	0.27	0.05	0.14	0.01	0.0022	0.0011	0.0194	0.0032	0.0041	0.0016	4.89	1.39	3.56	1.14	2.7	0.3
AB-9	04/21	1	380	630	0.21	0.04	0.92	0.05	0.0007	0.0010	0.0077	0.0013	–0.0005	0.0064	4.07	1.22	3.20	1.07	2.8	0.3
AB-10	04/21	1	380	630	0.25	0.05	0.38	0.02	0.0037	0.0010	0.0092	0.0014	0.0157	0.0069	4.53	1.32	3.57	1.14	2.7	0.3
AB-11	04/21	1	180	620	0.15	0.04	0.36	0.02	0.0020	0.0012	0.0030	0.0014	0.0019	0.0010	3.76	1.16	3.62	1.15	2.7	0.3
Frijoles Canyon:																				
Frijoles at Monument HQ	12/21	1	40	700	0.09	0.05	0.26	0.01											2.6	0.3
Frijoles at Rio Grande	12/21	1	–210	680	0.09	0.03	1.10	0.10											2.6	0.3
White Rock, Cañada del Buey																				
Site #1 Bonnie View South bank 1	10/28	1	550	640	0.17	0.03	1.08	0.06	0.0039	0.0011	0.0075	0.0014			3.46	1.10	2.76	1.01	3.5	0.4
Site #1 Bonnie View South bank 2	10/28	2	360	620	0.31	0.06	0.47	0.03	0.0020	0.0011	0.0142	0.0023			4.98	1.41	3.62	1.19	3.5	0.3
Site #1 Bonnie View Stream Channel 3	10/28	3	730	650	0.01	0.01	0.23	0.02	0.0004	0.0008	0.0041	0.0010			1.62	0.68	1.48	0.75	2.1	0.2
Site #2 Rover South bank 1	10/28	1	440	630	0.05	0.04	0.33	0.02	0.0004	0.0007	0.0037	0.0014			2.31	0.84	1.46	0.75	2.7	0.3
Site #2 Rover South bank 2	10/28	2	360	620	0.14	0.03	0.99	0.04	0.0009	0.0012	0.0097	0.0027			3.92	1.19	2.68	1.00	3.1	0.3
Site #2 Rover South bank 3	10/28	3	300	620	0.11	0.03	0.63	0.03	0.0015	0.0006	0.0146	0.0019			3.76	1.16	2.59	0.98	3.5	0.3
Site #2 Rover Stream Channel 4	10/28	4	810	660	0.01	0.03	0.85	0.04	0.0011	0.0006	0.0472	0.0032			2.01	0.77	1.58	0.77	1.8	0.2
Site #3 Lejano South bank 1	10/28	1	260	620	0.12	0.03	0.97	0.03	0.0023	0.0008	0.0055	0.0011			4.65	1.34	3.10	1.08	3.8	0.4
Site #3 Lejano South bank 2	10/28	2	390	630	0.10	0.02	1.40	0.10	0.0020	0.0007	0.0058	0.0012			3.92	1.19	2.85	1.03	3.5	0.3
Site #3 Lejano Stream Channel 3	10/28	3	350	620	0.05	0.04	0.92	0.07	0.0004	0.0004	0.0042	0.0010			2.33	0.85	1.80	0.82	2.3	0.2
Site #4 Meadow Lane South bank 1	10/28	1	740	650	0.09	0.03	0.64	0.02	0.0012	0.0008	0.0064	0.0013			3.49	1.10	2.74	1.01	3.9	0.4
Site #4 Meadow Lane South bank 2	10/28	2	330	620	0.04	0.04	0.48	0.02	0.0016	0.0009	0.0048	0.0010			3.86	1.18	3.44	1.15	3.7	0.4
Site #4 Meadow Lane South bank 3	10/28	3	100	610	0.16	0.03	1.00	0.10	0.0031	0.0009	0.0078	0.0014			3.92	1.19	2.91	1.04	3.1	0.3
Site #4 Meadow Lane Stream Channel 5	10/28	5	370	620	–0.01	0.14	0.52	0.03	0.0045	0.0012	0.0084	0.0016			2.96	0.99	1.98	0.85	2.7	0.3
Site #5 Overlook Park South bank 1	10/28	1	230	620	–0.01	0.22	0.38	0.03	0.0007	0.0005	0.0032	0.0011			2.83	0.96	2.44	0.95	3.1	0.3
Site #5 Overlook Park South bank 2	10/28	2	390	630	0.10	0.04	0.71	0.07	0.0054	0.0017	0.0101	0.0021			3.40	1.08	2.72	1.00	3.8	0.4
Site #5 Overlook Park South bank 3	10/28	3	350	620	0.16	0.04	0.84	0.06	0.0042	0.0011	0.7472	0.0262			4.34	1.28	2.52	0.96	3.2	0.3
Site #5 Overlook Park South bank 4	10/28	4	220	610	0.19	0.04	1.18	0.03	0.0005	0.0005	0.0131	0.0017			4.01	1.21	3.10	1.08	3.2	0.3
Site #5 Overlook Park Stream Channel 5	10/28	5	–240	580	0.07	0.04	0.12	0.02	0.0001	0.0004	0.0042	0.0011			1.29	0.59	1.52	0.76	2.8	0.3
Site #5 Overlook Park Stream Channel Dup 6	10/28	6	–50	590	0.06	0.04	0.68	0.04	0.0029	0.0009	0.0068	0.0012			2.20	0.82	1.66	0.79	2.4	0.2

Table 5-10. Radiochemical Analysis of Sediments for 1999 (pCi/g)[a,b] (Cont.)

Station Name	Date	Code[c]	^{3}H (pCi/L)		^{137}Cs		U (mg/kg)		^{238}Pu	^{239,240}Pu	^{241}Am	Gross Alpha		Gross Beta		Gross Gamma	
Pajarito Plateau Stations (Cont.)																	
Special EPA Sampling																	
Ancho Canyon 1	12/16	1	770	670			5.80	0.20									
Ancho Canyon 2	12/16	1	760	670			2.61	0.04									
Ancho Canyon 3	12/16	1	340	640			2.12	0.05									
Ancho Canyon 4	12/16	1	990	680			2.00	0.05									
Ancho Canyon 5	12/16	1	670	660			0.81	0.04									
Bayo Canyon 1	12/13	1	0	690	0.63	0.08	1.70	0.10				3.07	1.01	3.67	1.12	7.0	0.7
Bayo Canyon 2	12/13	1	40	700	0.27	0.04	1.33	0.06				3.60	1.13	3.90	1.17	7.0	0.7
Bayo Canyon 3	12/13	1	–10	690	0.20	0.03	0.97	0.04				3.27	1.06	2.86	0.94	7.6	0.8
Bayo Canyon 4	12/13	1	350	720	0.27	0.04	1.00	0.10				3.00	1.00	2.76	0.92	8.9	0.9
Cañada del Buey 1	12/15	1	300	630			0.79	0.02									
Cañada del Buey 2	12/15	1	290	630			0.74	0.03									
Cañada del Buey 3	12/16	1	–140	680	0.06	0.03	0.54	0.03								2.7	0.3
Cañada del Buey 4	12/15	1	270	630			1.47	0.05									
Cañada del Buey 4	12/15	2	340	640			0.70	0.04									
Cañada del Buey 5A	12/15	1	130	620			0.74	0.07									
Cañada del Buey 5B	12/16	1	–90	690	0.16	0.04	0.42	0.03								3.6	0.4
Cañada del Buey 6	12/15	1	300	630			0.74	0.07									
Cañada del Buey 7	12/15	1	300	630			0.30	0.02									
Cañada del Buey 8	12/15	1	150	620			0.81	0.06									
Mortandad Canyon 1	12/14	1	120	700			0.77	0.02									
Mortandad Canyon 2	12/14	1	190	710			0.60	0.04									
Mortandad Canyon 3	12/14	1	60	700			0.83	0.05									
Mortandad Canyon 4	12/14	1	900	750			0.38	0.02									
Mortandad Canyon 5A	12/14	1	100	700			0.90	0.10									
Mortandad Canyon 5B	12/14	1	–60	690			0.52	0.03									
Pajarito Canyon 1	12/16	1	460	650			1.24	0.06									
Pajarito Canyon 2	12/16	1	400	640			0.82	0.05									
Pajarito Canyon 3	12/16	1	160	620			1.34	0.06									
Pajarito Canyon 4	12/16	1	470	650			1.05	0.04									
Sandia Canyon 1	12/13	1	60	700	0.00	0.26	0.65	0.03				3.52	1.11	1.89	0.71	3.5	0.4
Sandia Canyon 2	12/13	1	110	700	0.10	0.04	0.53	0.01				5.58	1.53	3.58	1.10	3.8	0.4
Sandia Canyon 4	12/13	1	80	700	0.05	0.05	1.17	0.07				2.75	0.94	1.91	0.72	4.3	0.4
Sandia Canyon 3	12/13	1	3,190	880	0.10	0.04	1.12	0.06				3.22	1.05	2.32	0.82	3.6	0.4
Sandia Canyon 5	12/13	1	470	720	0.56	0.09	1.64	0.07				3.94	1.20	2.98	0.97	4.6	0.5
Sandia Canyon 6	12/13	1	330	710	0.09	0.03	1.54	0.06				3.30	1.06	2.73	0.91	7.0	0.7

Table 5-10. Radiochemical Analysis of Sediments for 1999 (pCi/g)[a,b] (Cont.)

Station Name	Date	Code[c]	^{3}H (pCi/L)	^{137}Cs	U (mg/kg)	^{238}Pu	$^{239,240}Pu$	^{241}Am	Gross Alpha	Gross Beta	Gross Gamma
Standardized Comparisons											
Average Detection Limits			700	0.05	0.25	0.0050[d]	0.0050[d]	0.0050	1.50	1.50	0.8
Background				0.44[e]	4.4[e]	0.006[e]	0.023[e]	0.09[f]	14.8[f]	12[f]	8.2[f]
SAL[g]			20,000	4.4	29	27	24	22			

[a] Except where noted. Two columns are listed; the first is the value; the second is the counting uncertainty (1 std dev).
[b] See Appendix B for an explanation of negative numbers.
[c] Codes: 1–primary analysis; 2–secondary analysis; R–lab replicate; D–lab duplicate.
[d] Sample sizes for ^{238}Pu and $^{239,240}Pu$ analysis: stream channels 100 g; reservoirs 1,000 g. Limits of detection for ^{238}Pu and $^{239,240}Pu$ in reservoir samples are 0.0001 pCi/g.
[e] Purtymun et al. (1987a), upper limit for background for sediment samples from 1974–1986.
[f] Preliminary upper limit for background values for channel sediments from 1974–1996 (McLin et al., in preparation).
[g] Screening Action Level, LANL Environmental Restoration Project, 1998; see text for details.

Table 5-11. Strontium-90 Sediments for 1999 (pCi/g)
(LANL's 1999 strontium-90 data are not valid because of analytical laboratory problems; the data appear in this report for documentary purposes only.)

Station Name	Date	Code[a]	Analyte	Value	Uncertainty	Detection Limit	Units	Detect?	Ratio of Value to Background	Ratio of Value to SAL
Rio Chama at Chamita	05/04	1	^{90}Sr	1.46	0.40	2.00	pCi/g	ND[b]		
Rio Grande at Embudo	05/04	1	^{90}Sr	1.62	0.40	2.00	pCi/g	ND		
Rio Grande at Otowi (bank)	08/03	1	^{90}Sr	0.71	0.45	0.95	pCi/g	ND		
Rio Grande at Cochiti	09/23	1	^{90}Sr	6.71	0.78	0.97	pCi/g	Detect	7.71	1.14
Rio Grande at Otowi Upper (bank)	08/03	1	^{90}Sr	1.34	0.44	0.85	pCi/g	Detect	1.54	0.23
Rio Grande at Bernalillo	05/04	1	^{90}Sr	2.00	0.41	2.00	pCi/g	Detect	2.30	0.34
Jemez River	08/02	1	^{90}Sr	1.66	0.45	0.84	pCi/g	Detect	1.91	0.28
Heron Upper	08/31	1	^{90}Sr	0.58	0.31	0.64	pCi/g	ND		
Heron Middle	08/31	1	^{90}Sr	0.80	0.37	0.75	pCi/g	ND		
Heron Lower	08/31	1	^{90}Sr	0.97	0.28	0.52	pCi/g	Detect	1.11	0.16
El Vado Upper	08/31	1	^{90}Sr	0.06	0.28	0.63	pCi/g	ND		
El Vado Middle	08/31	1	^{90}Sr	0.04	0.29	0.66	pCi/g	ND		
El Vado Lower	08/31	1	^{90}Sr	0.80	0.34	0.68	pCi/g	ND		
Abiquiu Middle	10/12	1	^{90}Sr	3.87	0.56	0.83	pCi/g	Detect	4.45	0.66
Abiquiu Middle	10/12	D	^{90}Sr	7.51	0.73	0.75	pCi/g	Detect	8.63	1.27
Abiquiu Lower	10/12	1	^{90}Sr	6.94	0.71	0.78	pCi/g	Detect	7.98	1.18
Abiquiu Lower	10/12	D	^{90}Sr	7.93	0.79	0.85	pCi/g	Detect	9.11	1.34
Rio Grande Upper	09/02	1	^{90}Sr	0.41	0.33	0.70	pCi/g	ND		
Rio Grande Middle	09/02	1	^{90}Sr	–0.74	0.38	0.80	pCi/g	ND		
Rio Grande Lower	09/02	1	^{90}Sr	–0.15	0.33	0.75	pCi/g	ND		
Rio Grande Lower	09/02	1	^{90}Sr	0.93	0.34	0.67	pCi/g	ND		
Cochiti Upper	10/13	1	^{90}Sr	–0.65	0.38	0.82	pCi/g	ND		
Cochiti Middle	10/13	1	^{90}Sr	8.12	0.82	0.90	pCi/g	Detect	9.33	1.38
Cochiti Middle	10/13	1	^{90}Sr	5.59	0.65	0.81	pCi/g	Detect	6.43	0.95
Cochiti Lower	10/13	1	^{90}Sr	7.50	0.78	0.87	pCi/g	Detect	8.62	1.27
Bayo at SR-502	08/03	1	^{90}Sr	1.37	0.45	0.86	pCi/g	Detect	1.57	0.23
Acid Weir	04/27	1	^{90}Sr	–0.80	0.38	0.81	pCi/g	ND		
Pueblo 1	04/27	1	^{90}Sr	–0.30	0.03	0.73	pCi/g	ND		
Pueblo 2	05/24	1	^{90}Sr	1.59	0.38	0.68	pCi/g	Detect	1.83	0.27
Hamilton Bend Spring	05/24	1	^{90}Sr	2.72	0.46	0.73	pCi/g	Detect	3.13	0.46
Pueblo 3	05/24	1	^{90}Sr	2.89	0.46	0.70	pCi/g	Detect	3.32	0.49
Pueblo 3	05/24	1	^{90}Sr	2.53	0.43	0.68	pCi/g	Detect	2.91	0.43

Table 5-11. Strontium-90 Sediments for 1999 (pCi/g) (Cont.)
(LANL's 1999 strontium-90 data are not valid because of analytical laboratory problems; the data appear in this report for documentary purposes only.)

Station Name	Date	Code[a]	Analyte	Value	Uncertainty	Detection Limit	Units	Detect?	Ratio of Value to Background	Ratio of Value to SAL
Pueblo at SR-502	08/04	1	^{90}Sr	2.15	0.48	0.82	pCi/g	Detect	2.47	0.36
Los Alamos at Bridge	04/27	1	^{90}Sr	–0.42	0.35	0.78	pCi/g	ND		
Los Alamos at Bridge	04/27	1	^{90}Sr	–0.08	0.34	0.77	pCi/g	ND		
Los Alamos at LAO-1	04/23	1	^{90}Sr	2.68	0.43	2.00	pCi/g	Detect	3.08	0.45
DPS-1	04/23	1	^{90}Sr	2.33	0.43	2.00	pCi/g	Detect	2.68	0.39
DPS-4	04/27	1	^{90}Sr	0.90	0.34	0.67	pCi/g	ND		
Los Alamos at Upper GS	04/23	1	^{90}Sr	1.93	0.41	2.00	pCi/g	ND		
Los Alamos at LAO-3	04/23	1	^{90}Sr	1.57	0.38	2.00	pCi/g	ND		
Los Alamos at LAO-3	04/23	1	^{90}Sr	1.57	0.38	2.00	pCi/g	ND		
Los Alamos at LAO-4.5	04/23	1	^{90}Sr	1.33	0.38	2.00	pCi/g	ND		
Los Alamos at SR-4	08/03	1	^{90}Sr	2.73	0.50	0.81	pCi/g	Detect	3.14	0.46
Los Alamos at Totavi	08/03	1	^{90}Sr	2.24	0.47	0.79	pCi/g	Detect	2.57	0.38
Los Alamos at Otowi	08/03	1	^{90}Sr	2.47	0.48	0.80	pCi/g	Detect	2.84	0.42
Sandia at SR-4	08/03	1	^{90}Sr	3.10	0.57	0.92	pCi/g	Detect	3.56	0.53
Mortandad near CMR Building	04/29	1	^{90}Sr	0.93	0.36	0.70	pCi/g	ND		
Mortandad west of GS-1	04/29	1	^{90}Sr	1.13	0.35	0.67	pCi/g	Detect	1.30	0.19
Mortandad at GS-1	04/29	1	^{90}Sr	2.51	0.44	0.70	pCi/g	Detect	2.89	0.43
Mortandad at MCO-5	04/29	1	^{90}Sr	2.86	0.45	0.67	pCi/g	Detect	3.29	0.48
Mortandad at MCO-5	04/29	1	^{90}Sr	1.72	0.41	0.73	pCi/g	Detect	1.98	0.29
Mortandad at MCO-7	04/29	1	^{90}Sr	0.78	0.33	0.65	pCi/g	ND		
Mortandad at MCO-9	04/29	1	^{90}Sr	0.83	0.36	0.72	pCi/g	ND		
Mortandad at MCO-13 (A-5)	08/05	1	^{90}Sr	1.95	0.44	0.77	pCi/g	Detect	2.24	0.33
Mortandad at MCO-13 (A-5)	08/05	1	^{90}Sr	2.51	0.46	0.75	pCi/g	Detect	2.89	0.43
Mortandad A-6	08/05	1	^{90}Sr	5.31	0.54	0.59	pCi/g	Detect	6.10	0.90
Mortandad A-7	08/05	1	^{90}Sr	3.40	0.50	0.73	pCi/g	Detect	3.91	0.58
Mortandad at SR-4 (A-9)	08/05	1	^{90}Sr	3.58	0.50	0.69	pCi/g	Detect	4.11	0.61
Mortandad at SR-4 (A-9)	08/05	1	^{90}Sr	2.27	0.46	0.77	pCi/g	Detect	2.61	0.38
Mortandad at Rio Grande (A-11)	09/20	1	^{90}Sr	2.07	0.41	0.68	pCi/g	Detect	2.38	0.35
Cañada del Buey at SR-4	05/24	1	^{90}Sr	1.56	0.39	0.70	pCi/g	Detect	1.79	0.26
CDB_01	07/20	1	^{90}Sr	3.89	0.48	2.00	pCi/g	Detect	4.47	0.66
CDB_02	07/20	1	^{90}Sr	4.89	0.55	2.00	pCi/g	Detect	5.62	0.83
CDB_02	07/20	1	^{90}Sr	4.09	0.49	2.00	pCi/g	Detect	4.70	0.69
CDB_02	07/20	1	^{90}Sr	2.98	0.47	2.00	pCi/g	Detect	3.43	0.51

Table 5-11. Strontium-90 Sediments for 1999 (pCi/g) (Cont.)
(LANL's 1999 strontium-90 data are not valid because of analytical laboratory problems; the data appear in this report for documentary purposes only.)

Station Name	Date	Code[a]	Analyte	Value	Uncertainty	Detection Limit	Units	Detect?	Ratio of Value to Background	Ratio of Value to SAL
G-0	04/14	1	^{90}Sr	5.67	0.57	0.60	pCi/g	Detect	6.52	0.96
G-0	04/14	1	^{90}Sr	5.63	0.57	0.61	pCi/g	Detect	6.47	0.95
G-1	04/14	1	^{90}Sr	2.91	0.44	0.64	pCi/g	Detect	3.34	0.49
G-2	04/14	1	^{90}Sr	1.92	0.39	0.66	pCi/g	Detect	2.21	0.33
G-3	04/14	1	^{90}Sr	3.11	0.43	0.60	pCi/g	Detect	3.57	0.53
G-4 R-1	04/14	1	^{90}Sr	2.50	0.41	0.63	pCi/g	Detect	2.87	0.42
G-4 R-2	04/14	1	^{90}Sr	3.56	0.46	0.61	pCi/g	Detect	4.09	0.60
G-5	04/14	1	^{90}Sr	2.97	0.44	0.65	pCi/g	Detect	3.41	0.50
G-6 R	04/14	1	^{90}Sr	2.20	0.40	0.65	pCi/g	Detect	2.53	0.37
G-7	04/15	1	^{90}Sr	3.35	0.46	2.00	pCi/g	Detect	3.85	0.57
G-7	04/15	1	^{90}Sr	3.02	0.46	2.00	pCi/g	Detect	3.47	0.51
G-8	04/14	1	^{90}Sr	3.57	0.47	0.64	pCi/g	Detect	4.10	0.61
G-9	04/14	1	^{90}Sr	2.33	0.42	0.68	pCi/g	Detect	2.68	0.39
G3_01	07/20	1	^{90}Sr	3.65	0.48	0.65	pCi/g	Detect	4.20	0.62
G3_01	07/20	1	^{90}Sr	3.04	0.47	0.69	pCi/g	Detect	3.49	0.52
G3_02	07/20	1	^{90}Sr	3.38	0.47	0.65	pCi/g	Detect	3.89	0.57
TWISP Dome at Silt Fence	07/29	1	^{90}Sr	0.60	0.33	0.69	pCi/g	ND		
Twomile at SR-501	03/31	1	^{90}Sr	3.25	0.56	0.88	pCi/g	Detect	3.74	0.55
Pajarito at SR-501	03/31	1	^{90}Sr	2.70	0.44	0.67	pCi/g	Detect	3.10	0.46
Pajarito at SR-4	04/15	1	^{90}Sr	4.31	0.51	2.00	pCi/g	Detect	4.95	0.73
Potrillo at SR-4	03/31	1	^{90}Sr	4.43	0.55	0.70	pCi/g	Detect	5.09	0.75
Fence at SR-4	04/15	1	^{90}Sr	4.55	0.53	2.00	pCi/g	Detect	5.23	0.77
Cañon de Valle at SR-501	03/31	1	^{90}Sr	4.38	0.49	0.58	pCi/g	Detect	5.03	0.74
Water at SR-501	03/31	1	^{90}Sr	3.24	0.46	0.64	pCi/g	Detect	3.72	0.55
Water at SR-4	03/31	1	^{90}Sr	3.94	0.49	0.64	pCi/g	Detect	4.53	0.67
Indio at SR-4	03/31	1	^{90}Sr	3.05	0.43	0.62	pCi/g	Detect	3.51	0.52
Ancho at SR-4	03/31	1	^{90}Sr	3.67	0.46	0.61	pCi/g	Detect	4.22	0.62
Ancho at SR-4	03/31	1	^{90}Sr	3.76	0.48	0.62	pCi/g	Detect	4.32	0.64
Above Ancho Spring	09/21	1	^{90}Sr	8.07	0.77	0.79	pCi/g	Detect	9.28	1.37
Ancho at Rio Grande	09/21	1	^{90}Sr	2.55	0.41	0.65	pCi/g	Detect	2.93	0.43

Table 5-11. Strontium-90 Sediments for 1999 (pCi/g) (Cont.)
(LANL's 1999 strontium-90 data are not valid because of analytical laboratory problems; the data appear in this report for documentary purposes only.)

Station Name	Date	Code[a]	Analyte	Value	Uncertainty	Detection Limit	Units	Detect?	Ratio of Value to Background	Ratio of Value to SAL
Chaquehui at Rio Grande	09/22	1	^{90}Sr	7.86	0.75	0.77	pCi/g	Detect	9.03	1.33
Chaquehui at Rio Grande	09/22	1	^{90}Sr	8.38	0.75	0.71	pCi/g	Detect	9.63	1.42
Chaquehui at Rio Grande	09/22	1	^{90}Sr	8.38	0.75	0.71	pCi/g	Detect	9.63	1.42
Chaquehui at Rio Grande	09/22	1	^{90}Sr	7.86	0.75	0.77	pCi/g	Detect	9.03	1.33
AB-1	04/21	1	^{90}Sr	2.75	0.44	0.66	pCi/g	Detect	3.16	0.47
AB-2	04/21	1	^{90}Sr	2.54	0.41	0.62	pCi/g	Detect	2.92	0.43
AB-3	04/15	1	^{90}Sr	4.64	0.55	2.00	pCi/g	Detect	5.33	0.79
AB-4	04/21	1	^{90}Sr	2.76	0.42	0.63	pCi/g	Detect	3.17	0.47
AB-4A	04/21	1	^{90}Sr	2.82	0.42	0.62	pCi/g	Detect	3.24	0.48
AB-5	04/21	1	^{90}Sr	1.78	0.42	0.73	pCi/g	Detect	2.05	0.30
AB-6	04/21	1	^{90}Sr	1.20	0.41	0.78	pCi/g	ND		
AB-7	04/21	1	^{90}Sr	1.45	0.39	0.72	pCi/g	Detect	1.67	0.25
AB-8	04/21	1	^{90}Sr	2.31	0.43	0.71	pCi/g	Detect	2.66	0.39
AB-9	04/21	1	^{90}Sr	2.53	0.43	0.68	pCi/g	Detect	2.91	0.43
AB-9	04/21	1	^{90}Sr	2.50	0.41	0.64	pCi/g	Detect	2.87	0.42
AB-10	04/21	1	^{90}Sr	1.40	0.35	0.62	pCi/g	Detect	1.61	0.24
AB-11	04/21	1	^{90}Sr	2.08	0.41	0.68	pCi/g	Detect	2.39	0.35
Site #1 Bonnie View South bank	10/28	1	^{90}Sr	10.47	1.33	1.75	pCi/g	Detect	12.03	1.77
Site #1 Bonnie View South bank	10/28	1	^{90}Sr	11.45	1.38	1.76	pCi/g	Detect	13.16	1.94
Site #1 BV Stream Channel	10/28	1	^{90}Sr	3.54	0.46	0.62	pCi/g	Detect	4.07	0.60
Site #2 Rover South bank	10/28	1	^{90}Sr	1.65	0.43	0.78	pCi/g	Detect	1.90	0.28
Site #2 Rover South bank	10/28	1	^{90}Sr	13.35	1.33	1.40	pCi/g	Detect	15.34	2.26
Site #2 Rover South bank	10/28	1	^{90}Sr	6.17	0.65	0.73	pCi/g	Detect	7.09	1.05
Site #2 Rover Stream Channel	10/28	1	^{90}Sr	2.90	0.45	0.68	pCi/g	Detect	3.33	0.49
Site #3 Lejano South bank	10/28	1	^{90}Sr	6.66	0.66	0.69	pCi/g	Detect	7.66	1.13
Site #3 Lejano South bank	10/28	1	^{90}Sr	4.52	0.59	0.79	pCi/g	Detect	5.20	0.77
Site #3 Lejano Stream Channel	10/28	1	^{90}Sr	4.94	0.57	0.70	pCi/g	Detect	5.68	0.84
Site #4 Meadow Lane South bank	10/28	1	^{90}Sr	5.39	0.66	0.84	pCi/g	Detect	6.20	0.91
Site #4 Meadow Lane South bank	10/28	1	^{90}Sr	5.71	0.65	0.77	pCi/g	Detect	6.56	0.97
Site #4 Meadow Lane South bank	10/28	1	^{90}Sr	7.39	0.70	0.69	pCi/g	Detect	8.49	1.25
Site #4 Meadow Lane Strm Channel	10/28	1	^{90}Sr	5.96	0.65	0.74	pCi/g	Detect	6.85	1.01

Table 5-11. Strontium-90 Sediments for 1999 (pCi/g) (Cont.)
(LANL's 1999 strontium-90 data are not valid because of analytical laboratory problems; the data appear in this report for documentary purposes only.)

Station Name	Date	Code[a]	Analyte	Value	Uncertainty	Detection Limit	Units	Detect?	Ratio of Value to Background	Ratio of Value to SAL
Site #5 Overlook Park South bank	10/28	1	^{90}Sr	4.45	0.58	0.78	pCi/g	Detect	5.11	0.75
Site #5 Overlook Park South bank	10/28	1	^{90}Sr	6.33	0.66	0.73	pCi/g	Detect	7.28	1.07
Site #5 Overlook Park South bank	10/28	1	^{90}Sr	5.18	0.55	0.61	pCi/g	Detect	5.95	0.88
Site #5 Overlook Park South bank	10/28	1	^{90}Sr	7.02	0.66	0.66	pCi/g	Detect	8.07	1.19
Site #5 Ovrlk Prk Strm Chnl	10/28	1	^{90}Sr	2.88	0.43	0.62	pCi/g	Detect	3.31	0.49
Site #5 Ovrlk Prk Strm Chnl	10/28	1	^{90}Sr	4.05	0.50	0.64	pCi/g	Detect	4.66	0.69

[a]Codes: 1–primary analysis; 2–secondary analysis; R–lab replicate; D–lab duplicate.
[b]ND = not detected.

Table 5-12. Detections of Greater-Than-Background Radionuclides in Sediments for 1999[a]

Station Name	Date	Code[b]	Analyte	Value	Uncertainty[c]	Detection Limit	Background	SAL	Units	Ratio of Value to Background	Ratio of Value to SAL
AB-2	04/21	1	^{239,240}Pu	0.0491	0.0063	0.0035	0.023	24	pCi/g	2.13	0.00
AB-3	04/15	1	^{241}Am	0.2536	0.0136	0.0037	0.09	22	pCi/g	2.82	0.01
AB-3	04/15	1	Gamma	9.2	0.9	0.2	8.2		pCi/g	1.12	
AB-3	04/15	1	^{238}Pu	0.0192	0.0028	0.0052	0.006	27	pCi/g	3.20	0.00
AB-3	04/15	1	^{239,240}Pu	1.0830	0.0380	0.0021	0.023	24	pCi/g	47.09	0.05
AB-5	04/21	1	^{137}Cs	0.90	0.11	0.09	0.44	4.4	pCi/g	2.05	0.21
AB-5	04/21	1	^{239,240}Pu	0.0268	0.0026	0.0024	0.023	24	pCi/g	1.17	0.00
AB-7	04/21	1	^{137}Cs	0.53	0.07	0.09	0.44	4.4	pCi/g	1.20	0.12
AB-7	04/21	1	U	4.80	0.20		4.4	29	mg/kg	1.09	0.17
Abiquiu Lower	10/12	1	^{3}H	3,320	930	820		20,000	pCi/L		0.17
Abiquiu Lower	10/12	D	^{3}H	6,500	1,100	1,200		20,000	pCi/L		0.33
Abiquiu Middle	10/12	D	^{3}H	4,440	980	990		20,000	pCi/L		0.22
Abiquiu Middle	10/12	1	^{3}H	3,090	920	810		20,000	pCi/L		0.15
Acid Weir	04/27	1	Alpha	16.00	3.54		14.8		pCi/g	1.08	
Acid Weir	04/27	1	^{241}Am	0.4200	0.0140	0.0020	0.09	22	pCi/g	4.67	0.02
Acid Weir	04/27	1	^{238}Pu	0.0290	0.0023	0.0017	0.006	27	pCi/g	4.83	0.00
Acid Weir	04/27	1	^{239,240}Pu	6.6021	0.1717	0.0011	0.023	24	pCi/g	287.05	0.28
Ancho at SR-4	03/31	1	^{3}H	3,040	810	410		20,000	pCi/L		0.15
Ancho at SR-4	03/31	1	^{3}H	3,870	860	410		20,000	pCi/L		0.19
Ancho Canyon 1	12/16	1	U	5.80	0.20		4.4	29	mg/kg	1.32	0.20
Bayo Canyon 1	12/13	1	^{137}Cs	0.63	0.08	0.09	0.44	4.4	pCi/g	1.42	0.14
Bayo Canyon 4	12/13	1	Gamma	8.9	0.9	0.2	8.2		pCi/g	1.09	
Cañon de Valle at SR-501	03/31	1	^{137}Cs	0.58	0.07	0.02	0.44	4.4	pCi/g	1.32	0.13
Cañon de Valle at SR-501	03/31	1	^{239,240}Pu	0.0387	0.0045	0.0029	0.023	24	pCi/g	1.68	0.00
Chaquehui at Rio Grande	09/22	1	^{137}Cs	0.65	0.09	0.10	0.44	4.4	pCi/g	1.47	0.15
Chaquehui at Rio Grande	09/22	1	^{137}Cs	0.69	0.11	0.09	0.44	4.4	pCi/g	1.57	0.16
Chaquehui at Rio Grande	09/22	1	^{239,240}Pu	0.0272	0.0035	0.0027	0.023	24	pCi/g	1.18	0.00
Chaquehui at Rio Grande	09/22	1	^{239,240}Pu	0.0456	0.0052	0.0056	0.023	24	pCi/g	1.98	0.00
DPS-1	04/23	1	^{241}Am	0.1087	0.0079	0.0053	0.09	22	pCi/g	1.21	0.00
DPS-1	04/23	1	^{238}Pu	0.0105	0.0018	0.0037	0.006	27	pCi/g	1.75	0.00
DPS-1	04/23	1	^{239,240}Pu	0.0246	0.0027	0.0018	0.023	24	pCi/g	1.07	0.00
DPS-4	04/27	1	^{241}Am	0.2562	0.0098	0.0023	0.09	22	pCi/g	2.85	0.01
DPS-4	04/27	1	^{137}Cs	1.59	0.18	0.09	0.44	4.4	pCi/g	3.61	0.36
DPS-4	04/27	1	^{238}Pu	0.0277	0.0036	0.0053	0.006	27	pCi/g	4.62	0.00

Table 5-12. Detections of Greater-Than-Background Radionuclides in Sediments for 1999[a] (Cont.)

Station Name	Date	Code[b]	Analyte	Value	Uncertainty[c]	Detection Limit	Background	SAL	Units	Ratio of Value to Background	Ratio of Value to SAL
DPS-4	04/27	1	^{239,240}Pu	0.0989	0.0071	0.0038	0.023	24	pCi/g	4.30	0.00
Fence at SR-4	04/15	1	^{137}Cs	0.52	0.06	0.04	0.44	4.4	pCi/g	1.18	0.12
Fence at SR-4	04/15	1	^{239,240}Pu	0.0273	0.0035	0.0022	0.023	24	pCi/g	1.19	0.00
G-7	04/15	1	^{241}Am	0.0926	0.0073	0.0047	0.09	22	pCi/g	1.03	0.00
G-0	04/14	1	^{241}Am	0.0916	0.0061	0.0027	0.09	22	pCi/g	1.02	0.00
G-4 R-1	04/14	1	^{3}H	4,100	880	420		20,000	pCi/L		0.21
G-7	04/15	1	^{3}H	3,100	800	390		20,000	pCi/L		0.16
G-7	04/15	1	^{3}H	3,010	790	400		20,000	pCi/L		0.15
G-4 R-2	04/14	1	^{3}H	2,560	790	420		20,000	pCi/L		0.13
G-9	04/14	1	^{238}Pu	0.3702	0.0161	0.0040	0.006	27	pCi/g	61.70	0.01
G-7	04/15	1	^{238}Pu	0.1624	0.0088	0.0033	0.006	27	pCi/g	27.07	0.01
G-7	04/15	1	^{238}Pu	0.1472	0.0082	0.0046	0.006	27	pCi/g	24.53	0.01
G-1	04/14	1	^{238}Pu	0.0245	0.0030	0.0035	0.006	27	pCi/g	4.08	0.00
G-0	04/14	1	^{238}Pu	0.0237	0.0030	0.0042	0.006	27	pCi/g	3.95	0.00
G-5	04/14	1	^{238}Pu	0.0132	0.0029	0.0066	0.006	27	pCi/g	2.20	0.00
G-0	04/14	1	^{238}Pu	0.0124	0.0024	0.0031	0.006	27	pCi/g	2.07	0.00
G3_01	07/20	1	^{238}Pu	0.0124	0.0022	0.0032	0.006	27	pCi/g	2.07	0.00
G3_02	07/20	1	^{238}Pu	0.0106	0.0022	0.0028	0.006	27	pCi/g	1.77	0.00
G-6 R	04/14	1	^{238}Pu	0.0097	0.0024	0.0036	0.006	27	pCi/g	1.62	0.00
G-8	04/14	1	^{238}Pu	0.0069	0.0018	0.0024	0.006	27	pCi/g	1.15	0.00
G-4 R-1	04/14	1	^{238}Pu	0.0066	0.0015	0.0024	0.006	27	pCi/g	1.10	0.00
G-9	04/14	1	^{239,240}Pu	0.4851	0.0199	0.0028	0.023	24	pCi/g	21.09	0.02
G-7	04/15	1	^{239,240}Pu	0.2612	0.0121	0.0057	0.023	24	pCi/g	11.36	0.01
G-6 R	04/14	1	^{239,240}Pu	0.2446	0.0144	0.0032	0.023	24	pCi/g	10.63	0.01
G-7	04/15	1	^{239,240}Pu	0.2189	0.0108	0.0040	0.023	24	pCi/g	9.52	0.01
G-0	04/14	1	^{239,240}Pu	0.1255	0.0087	0.0035	0.023	24	pCi/g	5.46	0.01
G-0	04/14	1	^{239,240}Pu	0.1072	0.0069	0.0033	0.023	24	pCi/g	4.66	0.00
G-4 R-2	04/14	1	^{239,240}Pu	0.0662	0.0052	0.0027	0.023	24	pCi/g	2.88	0.00
G-5	04/14	1	^{239,240}Pu	0.0570	0.0056	0.0043	0.023	24	pCi/g	2.48	0.00
G3_01	07/20	1	^{239,240}Pu	0.0519	0.0047	0.0021	0.023	24	pCi/g	2.26	0.00
G-4 R-1	04/14	1	^{239,240}Pu	0.0469	0.0043	0.0023	0.023	24	pCi/g	2.04	0.00
G3_01	07/20	1	^{239,240}Pu	0.0357	0.0038	0.0035	0.023	24	pCi/g	1.55	0.00
G3_02	07/20	1	^{239,240}Pu	0.0238	0.0032	0.0023	0.023	24	pCi/g	1.03	0.00
Guaje Reservoir	11/16	1	Alpha	22.30	4.73		14.8		pCi/g	1.51	

Table 5-12. Detections of Greater-Than-Background Radionuclides in Sediments for 1999[a] (Cont.)

Station Name	Date	Code[b]	Analyte	Value	Uncertainty[c]	Detection Limit	Background	SAL	Units	Ratio of Value to Background	Ratio of Value to SAL
Guaje Reservoir	11/16	D	Alpha	23.00	4.87		14.8		pCi/g	1.55	
Guaje Reservoir	11/16	D	Beta	13.30	3.05		12		pCi/g	1.11	
Guaje Reservoir	11/16	1	Beta	14.40	3.26		12		pCi/g	1.20	
Guaje Reservoir	11/16	1	^{137}Cs	0.51	0.10	0.14	0.44	4.4	pCi/g	1.15	0.12
Guaje Reservoir	11/16	1	^{137}Cs	0.56	0.07	0.07	0.44	4.4	pCi/g	1.26	0.13
Guaje Reservoir	11/16	1	U	10.90	0.60		4.4	29	mg/kg	2.48	0.38
Hamilton Bend Spring	05/24	1	^{239,240}Pu	0.5096	0.0209	0.0036	0.023	24	pCi/g	22.16	0.02
Jemez River	08/02	1	^{238}Pu	0.0063	0.0012	0.0023	0.006	27	pCi/g	1.05	0.00
Los Alamos at LAO-1	04/23	1	^{238}Pu	0.0141	0.0019	0.0031	0.006	27	pCi/g	2.35	0.00
Los Alamos at LAO-1	04/23	1	^{239,240}Pu	0.1384	0.0065	0.0019	0.023	24	pCi/g	6.02	0.01
Los Alamos at LAO-3	04/23	1	^{241}Am	0.1011	0.0061	0.0016	0.09	22	pCi/g	1.12	0.00
Los Alamos at LAO-3	04/23	1	^{137}Cs	0.69	0.08	0.03	0.44	4.4	pCi/g	1.56	0.16
Los Alamos at LAO-3	04/23	1	^{239,240}Pu	0.3185	0.0131	0.0015	0.023	24	pCi/g	13.85	0.01
Los Alamos at LAO-4.5	04/23	1	^{241}Am	0.1488	0.0086	0.0031	0.09	22	pCi/g	1.65	0.01
Los Alamos at LAO-4.5	04/23	1	^{137}Cs	1.26	0.14	0.02	0.44	4.4	pCi/g	2.86	0.29
Los Alamos at LAO-4.5	04/23	1	^{238}Pu	0.0233	0.0021	0.0013	0.006	27	pCi/g	3.88	0.00
Los Alamos at LAO-4.5	04/23	1	^{239,240}Pu	0.1088	0.0052	0.0019	0.023	24	pCi/g	4.73	0.00
Los Alamos at Otowi	08/03	1	^{239,240}Pu	0.0430	0.0040	0.0018	0.023	24	pCi/g	1.87	0.00
Los Alamos at SR-4	08/03	1	^{239,240}Pu	0.0344	0.0032	0.0023	0.023	24	pCi/g	1.50	0.00
Los Alamos at Upper GS	04/23	1	^{239,240}Pu	0.2182	0.0087	0.0014	0.023	24	pCi/g	9.49	0.01
Mortandad at GS-1	04/29	1	Alpha	82.50	16.90		14.8		pCi/g	5.57	
Mortandad at GS-1	04/29	1	Beta	20.70	5.17		12		pCi/g	1.73	
Mortandad at GS-1	04/29	1	^{137}Cs	16.50	1.80	0.11	0.44	4.4	pCi/g	37.50	3.75
Mortandad at GS-1	04/29	1	Gamma	16.2	1.6	0.2	8.2		pCi/g	1.98	
Mortandad at GS-1	04/29	1	^{3}H	4,870	900	410		20,000	pCi/L		0.24
Mortandad at GS-1	04/29	1	^{238}Pu	12.1292	0.3870	0.0049	0.006	27	pCi/g	2,021.53	0.45
Mortandad at GS-1	04/29	1	^{239,240}Pu	10.4218	0.3333	0.0027	0.023	24	pCi/g	453.12	0.43
Mortandad at MCO-5	04/29	1	Alpha	23.30	4.93		14.8		pCi/g	1.57	
Mortandad at MCO-5	04/29	1	Beta	17.10	0.45		12		pCi/g	1.43	
Mortandad at MCO-5	04/29	1	^{137}Cs	21.90	2.40	0.11	0.44	4.4	pCi/g	49.77	4.98
Mortandad at MCO-5	04/29	1	^{137}Cs	18.00	2.00	0.12	0.44	4.4	pCi/g	40.91	4.09
Mortandad at MCO-5	04/29	1	Gamma	20.4	2.0	0.2	8.2		pCi/g	2.49	
Mortandad at MCO-5	04/29	1	Gamma	16.5	1.6	0.2	8.2		pCi/g	2.01	
Mortandad at MCO-5	04/29	1	^{3}H	2,260	750	420		20,000	pCi/L		0.11

Table 5-12. Detections of Greater-Than-Background Radionuclides in Sediments for 1999[a] (Cont.)

Station Name	Date	Code[b]	Analyte	Value	Uncertainty[c]	Detection Limit	Background	SAL	Units	Ratio of Value to Background	Ratio of Value to SAL
Mortandad at MCO-5	04/29	1	^{3}H	3,500	830	420		20,000	pCi/L		0.18
Mortandad at MCO-5	04/29	1	^{238}Pu	3.2056	0.1131	0.0022	0.006	27	pCi/g	534.27	0.12
Mortandad at MCO-5	04/29	1	^{238}Pu	31.2870	1.1610	0.0334	0.006	27	pCi/g	5,214.50	1.16
Mortandad at MCO-5	04/29	1	$^{239,240}Pu$	8.0920	0.2771	0.0020	0.023	24	pCi/g	351.83	0.34
Mortandad at MCO-5	04/29	1	$^{239,240}Pu$	78.3171	2.8163	0.0222	0.023	24	pCi/g	3,405.09	3.26
Mortandad at MCO-7	04/29	1	^{137}Cs	4.21	0.47	0.09	0.44	4.4	pCi/g	9.57	0.96
Mortandad at MCO-7	04/29	1	^{238}Pu	0.6212	0.0302	0.0332	0.006	27	pCi/g	103.53	0.02
Mortandad at MCO-7	04/29	1	$^{239,240}Pu$	1.9244	0.0790	0.0038	0.023	24	pCi/g	83.67	0.08
Mortandad at MCO-9	04/29	1	^{238}Pu	0.0146	0.0030	0.0050	0.006	27	pCi/g	2.43	0.00
Mortandad at MCO-9	04/29	1	$^{239,240}Pu$	0.0497	0.0054	0.0047	0.023	24	pCi/g	2.16	0.00
Mortandad near CMR Building	04/29	1	^{238}Pu	0.0324	0.0045	0.0066	0.006	27	pCi/g	5.40	0.00
Mortandad West of GS-1	04/29	1	^{238}Pu	0.0159	0.0031	0.0043	0.006	27	pCi/g	2.65	0.00
Mortandad West of GS-1	04/29	1	$^{239,240}Puu$	0.0409	0.0050	0.0037	0.023	24	pCi/g	1.78	0.00
Pajarito at SR-4	04/15	1	^{137}Cs	0.58	0.06	0.03	0.44	4.4	pCi/g	1.32	0.13
Pajarito at SR-4	04/15	1	^{238}Pu	0.4241	0.0183	0.0040	0.006	27	pCi/g	70.68	0.02
Pajarito at SR-4	04/15	1	$^{239,240}Pu$	0.0701	0.0055	0.0030	0.023	24	pCi/g	3.05	0.00
Pueblo 2	05/24	1	$^{239,240}Pu$	0.9672	0.0313	0.0013	0.023	24	pCi/g	42.05	0.04
Pueblo 3	05/24	1	$^{239,240}Pu$	0.1796	0.0083	0.0017	0.023	24	pCi/g	7.81	0.01
Pueblo 3	05/24	1	$^{239,240}Pu$	0.2046	0.0092	0.0018	0.023	24	pCi/g	8.90	0.01
Pueblo at SR-502	08/04	1	$^{239,240}Pu$	1.0782	0.0336	0.0056	0.023	24	pCi/g	46.88	0.04
Rio Grande at Bernalillo	05/04	1	^{238}Pu	0.0100	0.0029	0.0044	0.006	27	pCi/g	1.67	0.00
Rio Grande Lower	09/02	1	^{137}Cs	0.57	0.08	0.09	0.44	4.4	pCi/g	1.30	0.13
Rio Grande Lower	09/02	1	^{137}Cs	0.53	0.07	0.08	0.44	4.4	pCi/g	1.20	0.12
Rio Grande Upper	09/02	1	^{137}Cs	0.67	0.08	0.08	0.44	4.4	pCi/g	1.53	0.15
Sandia Canyon 3	12/13	1	^{3}H	3,190	880	410		20,000	pCi/L		0.16
Sandia Canyon 5	12/13	1	^{137}Cs	0.57	0.09	0.11	0.44	4.4	pCi/g	1.28	0.13
Site #2 Rover Stream Channel 4	10/28	1	$^{239,240}Pu$	0.0472	0.0032	0.0017	0.023	24	pCi/g	2.05	0.00
Site #5 Overlook Park South bank 3	10/28	1	$^{239,240}Pu$	0.7472	0.0262	0.0013	0.023	24	pCi/g	32.49	0.03
TWISP Dome at Silt Fence	07/29	1	^{3}H	6,800	1,000	400		20,000	pCi/L		0.34

[a] Above background detection defined as ≥ 3× uncertainty and ≥ detection limit and ≥ background.
[b] Codes: 1–primary analysis; 2–secondary analysis; R–lab replicate; D–lab duplicate.
[c] Radioactivity counting uncertainty (1 std dev).

Table 5-13. Detections of Greater-Than-Background Strontium-90 in Sediments for 1999[a]
(LANL's 1999 strontium-90 data are not valid because of analytical laboratory problems; the data appear in this report for documentary purposes only.)

Station Name	Date	Code[b]	Analyte	Value	Uncertainty[c]	Detection Limit	Background	SAL	Units	Ratio of Value to Background	Ratio of Value to SAL
AB-1	04/21	1	^{90}Sr	2.75	0.44	0.66	0.87	5.9	pCi/g	3.16	0.47
AB-10	04/21	1	^{90}Sr	1.40	0.35	0.62	0.87	5.9	pCi/g	1.61	0.24
AB-11	04/21	1	^{90}Sr	2.08	0.41	0.68	0.87	5.9	pCi/g	2.39	0.35
AB-2	04/21	1	^{90}Sr	2.54	0.41	0.62	0.87	5.9	pCi/g	2.92	0.43
AB-3	04/15	1	^{90}Sr	4.64	0.55	2.00	0.87	5.9	pCi/g	5.33	0.79
AB-4	04/21	1	^{90}Sr	2.76	0.42	0.63	0.87	5.9	pCi/g	3.17	0.47
AB-4A	04/21	1	^{90}Sr	2.82	0.42	0.62	0.87	5.9	pCi/g	3.24	0.48
AB-5	04/21	1	^{90}Sr	1.78	0.42	0.73	0.87	5.9	pCi/g	2.05	0.30
AB-7	04/21	1	^{90}Sr	1.45	0.39	0.72	0.87	5.9	pCi/g	1.67	0.25
AB-8	04/21	1	^{90}Sr	2.31	0.43	0.71	0.87	5.9	pCi/g	2.66	0.39
AB-9	04/21	1	^{90}Sr	2.50	0.41	0.64	0.87	5.9	pCi/g	2.87	0.42
AB-9	04/21	1	^{90}Sr	2.53	0.43	0.68	0.87	5.9	pCi/g	2.91	0.43
Abiquiu Lower	10/12	1	^{90}Sr	6.94	0.71	0.78	0.87	5.9	pCi/g	7.98	1.18
Abiquiu Lower	10/12	D	^{90}Sr	7.93	0.79	0.85	0.87	5.9	pCi/g	9.11	1.34
Abiquiu Middle	10/12	1	^{90}Sr	3.87	0.56	0.83	0.87	5.9	pCi/g	4.45	0.66
Abiquiu Middle	10/12	D	^{90}Sr	7.51	0.73	0.75	0.87	5.9	pCi/g	8.63	1.27
Above Ancho Spring	09/21	1	^{90}Sr	8.07	0.77	0.79	0.87	5.9	pCi/g	9.28	1.37
Ancho at Rio Grande	09/21	1	^{90}Sr	2.55	0.41	0.65	0.87	5.9	pCi/g	2.93	0.43
Ancho at SR-4	03/31	1	^{90}Sr	3.67	0.46	0.61	0.87	5.9	pCi/g	4.22	0.62
Ancho at SR-4	03/31	1	^{90}Sr	3.76	0.48	0.62	0.87	5.9	pCi/g	4.32	0.64
Bayo at SR-502	08/03	1	^{90}Sr	1.37	0.45	0.86	0.87	5.9	pCi/g	1.57	0.23
Cañada del Buey at SR-4	05/24	1	^{90}Sr	1.56	0.39	0.70	0.87	5.9	pCi/g	1.79	0.26
Cañon de Valle at SR-501	03/31	1	^{90}Sr	4.38	0.49	0.58	0.87	5.9	pCi/g	5.03	0.74
CDB_01	07/20	1	^{90}Sr	3.89	0.48	2.00	0.87	5.9	pCi/g	4.47	0.66
CDB_02	07/20	1	^{90}Sr	2.98	0.47	2.00	0.87	5.9	pCi/g	3.43	0.51
CDB_02	07/20	1	^{90}Sr	4.09	0.49	2.00	0.87	5.9	pCi/g	4.70	0.69
CDB_02	07/20	1	^{90}Sr	4.89	0.55	2.00	0.87	5.9	pCi/g	5.62	0.83
Chaquehui at Rio Grande	09/22	1	^{90}Sr	7.86	0.75	0.77	0.87	5.9	pCi/g	9.03	1.33
Chaquehui at Rio Grande	09/22	1	^{90}Sr	8.38	0.75	0.71	0.87	5.9	pCi/g	9.63	1.42
Cochiti Lower	10/13	1	^{90}Sr	7.50	0.78	0.87	0.87	5.9	pCi/g	8.62	1.27
Cochiti Middle	10/13	1	^{90}Sr	5.59	0.65	0.81	0.87	5.9	pCi/g	6.43	0.95
Cochiti Middle	10/13	1	^{90}Sr	8.12	0.82	0.90	0.87	5.9	pCi/g	9.33	1.38

Table 5-13. Detections of Greater-Than-Background Strontium-90 in Sediments for 1999[a] (Cont.)
(LANL's 1999 strontium-90 data are not valid because of analytical laboratory problems; the data appear in this report for documentary purposes only.)

Station Name	Date	Code[b]	Analyte	Value	Uncertainty[c]	Detection Limit	Background	SAL	Units	Ratio of Value to Background	Ratio of Value to SAL
DPS-1	04/23	1	^{90}Sr	2.33	0.43	2.00	0.87	5.9	pCi/g	2.68	0.39
Fence at SR-4	04/15	1	^{90}Sr	4.55	0.53	2.00	0.87	5.9	pCi/g	5.23	0.77
G-0	04/14	1	^{90}Sr	5.63	0.57	0.61	0.87	5.9	pCi/g	6.47	0.95
G-0	04/14	1	^{90}Sr	5.67	0.57	0.60	0.87	5.9	pCi/g	6.52	0.96
G-1	04/14	1	^{90}Sr	2.91	0.44	0.64	0.87	5.9	pCi/g	3.34	0.49
G-2	04/14	1	^{90}Sr	1.92	0.39	0.66	0.87	5.9	pCi/g	2.21	0.33
G-3	04/14	1	^{90}Sr	3.11	0.43	0.60	0.87	5.9	pCi/g	3.57	0.53
G3_01	07/20	1	^{90}Sr	3.04	0.47	0.69	0.87	5.9	pCi/g	3.49	0.52
G3_01	07/20	1	^{90}Sr	3.65	0.48	0.65	0.87	5.9	pCi/g	4.20	0.62
G3_02	07/20	1	^{90}Sr	3.38	0.47	0.65	0.87	5.9	pCi/g	3.89	0.57
G-4 R-1	04/14	1	^{90}Sr	2.50	0.41	0.63	0.87	5.9	pCi/g	2.87	0.42
G-4 R-2	04/14	1	^{90}Sr	3.56	0.46	0.61	0.87	5.9	pCi/g	4.09	0.60
G-5	04/14	1	^{90}Sr	2.97	0.44	0.65	0.87	5.9	pCi/g	3.41	0.50
G-6 R	04/14	1	^{90}Sr	2.20	0.40	0.65	0.87	5.9	pCi/g	2.53	0.37
G-7	04/15	1	^{90}Sr	3.02	0.46	2.00	0.87	5.9	pCi/g	3.47	0.51
G-7	04/15	1	^{90}Sr	3.35	0.46	2.00	0.87	5.9	pCi/g	3.85	0.57
G-8	04/14	1	^{90}Sr	3.57	0.47	0.64	0.87	5.9	pCi/g	4.10	0.61
G-9	04/14	1	^{90}Sr	2.33	0.42	0.68	0.87	5.9	pCi/g	2.68	0.39
Hamilton Bend Spring	05/24	1	^{90}Sr	2.72	0.46	0.73	0.87	5.9	pCi/g	3.13	0.46
Heron Lower	08/31	1	^{90}Sr	0.97	0.28	0.52	0.87	5.9	pCi/g	1.11	0.16
Indio at SR-4	03/31	1	^{90}Sr	3.05	0.43	0.62	0.87	5.9	pCi/g	3.51	0.52
Jemez River	08/02	1	^{90}Sr	1.66	0.45	0.84	0.87	5.9	pCi/g	1.91	0.28
Los Alamos at LAO-1	04/23	1	^{90}Sr	2.68	0.43	2.00	0.87	5.9	pCi/g	3.08	0.45
Los Alamos at Otowi	08/03	1	^{90}Sr	2.47	0.48	0.80	0.87	5.9	pCi/g	2.84	0.42
Los Alamos at SR-4	08/03	1	^{90}Sr	2.73	0.50	0.81	0.87	5.9	pCi/g	3.14	0.46
Los Alamos at Totavi	08/03	1	^{90}Sr	2.24	0.47	0.79	0.87	5.9	pCi/g	2.57	0.38
Mortandad A-6	08/05	1	^{90}Sr	5.31	0.54	0.59	0.87	5.9	pCi/g	6.10	0.90
Mortandad A-7	08/05	1	^{90}Sr	3.40	0.50	0.73	0.87	5.9	pCi/g	3.91	0.58
Mortandad at GS-1	04/29	1	^{90}Sr	2.51	0.44	0.70	0.87	5.9	pCi/g	2.89	0.43
Mortandad at MCO-13 (A-5)	08/05	1	^{90}Sr	1.95	0.44	0.77	0.87	5.9	pCi/g	2.24	0.33
Mortandad at MCO-13 (A-5)	08/05	1	^{90}Sr	2.51	0.46	0.75	0.87	5.9	pCi/g	2.89	0.43
Mortandad at MCO-5	04/29	1	^{90}Sr	1.72	0.41	0.73	0.87	5.9	pCi/g	1.98	0.29

Table 5-13. Detections of Greater-Than-Background Strontium-90 in Sediments for 1999[a] (Cont.)
(LANL's 1999 strontium-90 data are not valid because of analytical laboratory problems; the data appear in this report for documentary purposes only.)

Station Name	Date	Code[b]	Analyte	Value	Uncertainty[c]	Detection Limit	Background	SAL	Units	Ratio of Value to Background	Ratio of Value to SAL
Mortandad at MCO-5	04/29	1	^{90}Sr	2.86	0.45	0.67	0.87	5.9	pCi/g	3.29	0.48
Mortandad at Rio Grande (A-11)	09/20	1	^{90}Sr	2.07	0.41	0.68	0.87	5.9	pCi/g	2.38	0.35
Mortandad at SR-4 (A-9)	08/05	1	^{90}Sr	2.27	0.46	0.77	0.87	5.9	pCi/g	2.61	0.38
Mortandad at SR-4 (A-9)	08/05	1	^{90}Sr	3.58	0.50	0.69	0.87	5.9	pCi/g	4.11	0.61
Mortandad West of GS-1	04/29	1	^{90}Sr	1.13	0.35	0.67	0.87	5.9	pCi/g	1.30	0.19
Pajarito at SR-4	04/15	1	^{90}Sr	4.31	0.51	2.00	0.87	5.9	pCi/g	4.95	0.73
Pajarito at SR-501	03/31	1	^{90}Sr	2.70	0.44	0.67	0.87	5.9	pCi/g	3.10	0.46
Potrillo at SR-4	03/31	1	^{90}Sr	4.43	0.55	0.70	0.87	5.9	pCi/g	5.09	0.75
Pueblo 2	05/24	1	^{90}Sr	1.59	0.38	0.68	0.87	5.9	pCi/g	1.83	0.27
Pueblo 3	05/24	1	^{90}Sr	2.53	0.43	0.68	0.87	5.9	pCi/g	2.91	0.43
Pueblo 3	05/24	1	^{90}Sr	2.89	0.46	0.70	0.87	5.9	pCi/g	3.32	0.49
Pueblo at SR-502	08/04	1	^{90}Sr	2.15	0.48	0.82	0.87	5.9	pCi/g	2.47	0.36
Rio Grande at Bernalillo	05/04	1	^{90}Sr	2.00	0.41	2.00	0.87	5.9	pCi/g	2.30	0.34
Rio Grande at Cochiti	09/23	1	90Sr	6.71	0.78	0.97	0.87	5.9	pCi/g	7.71	1.14
Rio Grande at Otowi Upper (bank)	08/03	1	^{90}Sr	1.34	0.44	0.85	0.87	5.9	pCi/g	1.54	0.23
Sandia at SR-4	08/03	1	^{90}Sr	3.10	0.57	0.92	0.87	5.9	pCi/g	3.56	0.53
Site #1 Bonnie View South bank	10/28	1	^{90}Sr	10.47	1.33	1.75	0.87	5.9	pCi/g	12.03	1.77
Site #1 Bonnie View South bank	10/28	1	^{90}Sr	11.45	1.38	1.76	0.87	5.9	pCi/g	13.16	1.94
Site #1 BV Stream Channel	10/28	1	^{90}Sr	3.54	0.46	0.62	0.87	5.9	pCi/g	4.07	0.60
Site #2 Rover South bank	10/28	1	^{90}Sr	1.65	0.43	0.78	0.87	5.9	pCi/g	1.90	0.28
Site #2 Rover South bank	10/28	1	^{90}Sr	6.17	0.65	0.73	0.87	5.9	pCi/g	7.09	1.05
Site #2 Rover South bank	10/28	1	^{90}Sr	13.35	1.33	1.40	0.87	5.9	pCi/g	15.34	2.26
Site #2 Rover Stream Channel	10/28	1	^{90}Sr	2.90	0.45	0.68	0.87	5.9	pCi/g	3.33	0.49
Site #3 Lejano South bank	10/28	1	^{90}Sr	4.52	0.59	0.79	0.87	5.9	pCi/g	5.20	0.77
Site #3 Lejano South bank	10/28	1	^{90}Sr	6.66	0.66	0.69	0.87	5.9	pCi/g	7.66	1.13
Site #3 Lejano Stream Channel	10/28	1	^{90}Sr	4.94	0.57	0.70	0.87	5.9	pCi/g	5.68	0.84
Site #4 Meadow Ln. South bank	10/28	1	^{90}Sr	5.39	0.66	0.84	0.87	5.9	pCi/g	6.20	0.91
Site #4 Meadow Ln. South bank	10/28	1	^{90}Sr	5.71	0.65	0.77	0.87	5.9	pCi/g	6.56	0.97
Site #4 Meadow Ln. South bank	10/28	1	^{90}Sr	7.39	0.70	0.69	0.87	5.9	pCi/g	8.49	1.25
Site #4 Meadow Ln. Strm Channel	10/28	1	^{90}Sr	5.96	0.65	0.74	0.87	5.9	pCi/g	6.85	1.01
Site #5 Overlook Park South bank	10/28	1	^{90}Sr	4.45	0.58	0.78	0.87	5.9	pCi/g	5.11	0.75
Site #5 Overlook Park South bank	10/28	1	^{90}Sr	5.18	0.55	0.61	0.87	5.9	pCi/g	5.95	0.88

Table 5-13. Detections of Greater-Than-Background Strontium-90 in Sediments for 1999[a] (Cont.)
(LANL's 1999 strontium-90 data are not valid because of analytical laboratory problems; the data appear in this report for documentary purposes only.)

Station Name	Date	Code[b]	Analyte	Value	Uncertainty[c]	Detection Limit	Background	SAL	Units	Ratio of Value to Background	Ratio of Value to SAL
Site #5 Overlook Park South bank	10/28	1	^{90}Sr	6.33	0.66	0.73	0.87	5.9	pCi/g	7.28	1.07
Site #5 Overlook Park South bank	10/28	1	^{90}Sr	7.02	0.66	0.66	0.87	5.9	pCi/g	8.07	1.19
Site #5 Ovrlk Prk Strm Chnl	10/28	1	^{90}Sr	2.88	0.43	0.62	0.87	5.9	pCi/g	3.31	0.49
Site #5 Ovrlk Prk Strm Chnl	10/28	1	^{90}Sr	4.05	0.50	0.64	0.87	5.9	pCi/g	4.66	0.69
Twomile at SR-501	03/31	1	^{90}Sr	3.25	0.56	0.88	0.87	5.9	pCi/g	3.74	0.55
Water at SR-4	03/31	1	^{90}Sr	3.94	0.49	0.64	0.87	5.9	pCi/g	4.53	0.67
Water at SR-501	03/31	1	^{90}Sr	3.24	0.46	0.64	0.87	5.9	pCi/g	3.72	0.55

[a] Above background detection defined as ≥ 3× uncertainty and ≥ detection limit and ≥ background.
[b] Codes: 1–primary analysis; 2–secondary analysis; R–lab replicate; D–lab duplicate.
[c] Radioactivity counting uncertainty (1 std dev).

Table 5-14. Total Recoverable Trace Metals in Sediments for 1999 (mg/kg[a])

Station Name	Date	Code[b]	Ag	Al	As	B	Ba	Be	Cd	Co	Cr	Cu	Fe	Hg
Regional Stations														
Rio Grande at Frijoles (bank)	12/21	1	<0.4	4,812	1.3	2	82.6	0.1	0.6	3.0	6.7	4.6	7,282	<0.010
Rio Grande at Cochiti Spillway	09/23	1	<0.4	6,626	1.8	<1	143.7	0.3	<0.2	4.0	8.1	5.4	9,229	<0.010
Reservoirs on Rio Chama (New Mexico)														
Heron Upper	08/31	1	<0.4	27,406	7.0	7	124.6	0.8	<0.2	8.8	18.2	19.4	24,067	<0.010
Heron Middle	08/31	1	<0.4	29,083	8.0	20	100.6	0.8	1.1	4.1	22.6	10.5	14,293	0.010
Heron Lower	08/31	1	<0.4	39,486	14.0	<10	307.7	1.8	1.3	12.9	36.2	20.8	33,372	0.010
Abiquiu Upper	08/30	1	<0.4	46,050	11.0	24	197.4	1.5	1.2	10.4	37.4	22.0	29,403	<0.010
Abiquiu Middle	10/12	1	<0.4	25,471	4.0	<1	266.9	1.6	<1.0	10.6	27.2	24.5	26,643	<0.100
Abiquiu Lower	10/12	1	<0.4	9,633	2.5	6	103.6	0.8	<0.5	4.1	14.6	9.2	13,681	<0.100
Reservoirs on Rio Grande (New Mexico)														
Cochiti Upper	10/13	1	<0.4	38,033	4.6	6	210.9	0.8	<1.5	7.8	24.4	19.4	26,250	<0.010
Cochiti Middle	10/13	1	<0.4	17,689	5.0	<1	269.0	0.7	0.9	7.9	14.4	16.3	17,814	<0.010
Cochiti Middle	10/13	2	<0.4	29,953	5.0	<1	288.4	0.6	<1.6	8.3	21.5	18.5	24,550	<0.010
Cochiti Lower	10/13	1	<0.4	22,407	5.0	<1	245.6	0.6	<1.3	9.3	17.9	20.2	21,339	<0.010
Other Reservoirs (New Mexico)														
Guaje Reservoir	11/16	1	<0.4	9,475	2.0	<1	83.8	0.1	<1.7	<5.5	19.2	11.6	8,918	<0.010
Acid/Pueblo Canyons:														
Acid Weir	04/27	1	<2.0	1,747	1.0	<3	17.3	0.4	<0.4	<1.0	3.9	<5.7	5,821	<0.030
Pueblo 1	04/27	1	<2.0	1,283	0.3	<3	21.5	0.3	<0.4	<1.0	1.1	<5.1	3,133	<0.030
Pueblo 2	05/24	D	<0.4	1,728	<0.3	<1	22.6	0.3	<0.2	0.7	1.3	2.0	4,585	<0.030
Hamilton Bend Spring	05/24	D	<0.4	3,608	0.5	<1	30.0	0.5	<0.2	1.3	2.6	3.0	5,183	<0.030
Pueblo 3	05/24	D	<0.4	2,432	0.8	<1	17.1	0.2	<0.2	0.4	2.2	22.2	2,999	<0.030
Pueblo at SR-502	08/04	1	<0.4	3,256	7.5	<1	297.7	0.3	<0.2	27.3	2.7	4.1	10,943	<0.010
DP/Los Alamos Canyons:														
Los Alamos at Bridge	04/27	1	<2.0	2,047	0.7	<3	25.1	0.4	<0.4	<1.0	2.2	7.1	3,995	<0.030
Los Alamos at Bridge	04/27	2	<2.0	4,743	<1.0	<3	56.7	0.7	<0.4	<2.6	5.4	9.7	6,323	<0.030
Los Alamos at LAO-1	04/23	1	<0.4	2,624	<0.3	<1	32.2	0.2	<0.2	0.9	3.4	2.5	4,212	<0.030

Table 5-14. Total Recoverable Trace Metals in Sediments for 1999 (mg/kg[a]) (Cont.)

Station Name	Date	Code[b]	Ag	Al	As	B	Ba	Be	Cd	Co	Cr	Cu	Fe	Hg
DP/Los Alamos Canyons: (Cont.)														
DPS-1	04/23	1	<0.4	1,486	0.6	<1	15.1	0.1	<0.2	1.1	2.7	1.7	4,596	<0.030
DPS-4	04/27	1	<2.0	1,678	0.2	<3	20.1	0.5	<0.4	<1.0	2.0	4.1	3,014	<0.030
Los Alamos at Upper GS	04/23	1	<0.4	1,637	0.6	<1	40.1	0.1	<0.2	2.0	3.4	0.9	3,814	<0.030
Los Alamos at LAO-3	04/23	1	<0.4	1,391	<0.3	<1	13.5	0.1	<0.2	0.7	1.8	3.3	4,019	<0.030
Los Alamos at LAO-4.5	04/23	1	<0.4	1,315	<0.3	<1	15.2	<0.1	<0.2	<0.6	1.6	2.0	2,622	<0.030
Los Alamos at SR-4	08/03	1	<0.4	3,308	<0.5	<1	28.3	0.4	<0.2	1.5	2.4	1.3	3,996	<0.010
Sandia Canyon:														
Sandia at SR-4	08/03	1	1.3	1,049	<0.3	<1	22.3	0.2	<0.2	<0.4	<1.1	0.6	1,359	<0.010
Mortandad Canyon:														
Mortandad near CMR Building	04/29	1	<0.4	2,594	0.7	<1	35.3	0.2	<0.2	1.8	3.4	4.5	6,393	<0.004
Mortandad West of GS-1	04/29	1	<0.4	4,988	1.5	<1	68.6	0.4	<0.2	2.2	6.5	4.4	8,774	0.019
Mortandad at GS-1	04/29	1	<0.4	2,294	0.7	<1	18.6	0.3	<0.2	0.9	3.1	6.5	4,720	0.025
Mortandad at MCO-5	04/29	2	<0.4	2,340	<0.3	<1	15.6	0.2	<0.2	1.5	3.7	2.0	14,422	0.009
Mortandad at MCO-5	04/29	1	<0.4	1,075	<0.3	<1	14.7	0.1	<0.2	0.7	2.1	2.3	5,056	0.009
Mortandad at MCO-7	04/29	1	<9.1	<1,957	<0.3	<1	<14.5	<0.1	<0.2	<0.4	<2.2	<0.3	<4,816	<0.004
Mortandad at MCO-9	04/29	1	<0.4	2,566	0.3	<1	19.9	<0.2	<0.2	0.7	2.0	1.4	4,577	<0.004
Mortandad at MCO-13 (A-5)	08/05	2	<0.4	5,735	0.9	<1	39.0	0.4	<0.2	1.5	3.9	2.4	5,813	<0.010
Mortandad at MCO-13 (A-5)	08/05	1	1.2	1,391	0.5	<1	32.1	0.3	<0.2	<1.1	1.1	1.4	1,916	<0.010
Mortandad at SR-4 (A-9)	08/05	1	<0.4	7,738	1.0	<1	57.4	0.5	0.2	2.4	5.8	2.5	7,537	<0.010
Mortandad at SR-4 (A-9)	08/05	2	<0.4	5,023	0.7	<1	42.8	0.4	<0.2	1.7	3.7	1.8	5,268	<0.010
Mortandad at Rio Grande (A-11)	09/20	1	<0.4	2,210	0.4	<1	47.9	0.1	<0.2	<1.7	2.5	2.3	3,954	<0.010
Cañada del Buey:														
Cañada del Buey at SR-4	05/24	D	<0.4	2,117	0.4	3	38.6	0.2	<0.2	1.6	1.3	1.4	3,075	<0.030
CDB_01	07/20	1												<0.030
CDB_02	07/20	2												<0.030
CDB_02	07/20	3												<0.030
CDB_02	07/20	1												<0.030

Table 5-14. Total Recoverable Trace Metals in Sediments for 1999 (mg/kg[a]) (Cont.)

Station Name	Date	Code[b]	Ag	Al	As	B	Ba	Be	Cd	Co	Cr	Cu	Fe	Hg
TA-54, Area G:														
G-0	04/14	1	<0.5	8,300	1.5	3	72.0	0.7	<0.2	1.5	7.6	6.1	9,800	<0.050
G-0	04/14	2	0.4	7,700	1.4	2	72.0	0.7	0.1	1.5	6.5	5.8	9,000	<0.050
G-1	06/09	1												<0.020
G-2	06/09	1												<0.020
G-3	06/09	1												<0.020
G-4 R-1	04/14	1	0.5	5,700	1.0	2	48.0	0.6	<0.2	1.1	6.6	4.0	7,200	<0.050
G-4 R-2	04/14	1	<0.8	2,800	<1.0	<1	52.0	0.6	1,800.0	0.8	4.1	5.5	3,400	<0.050
G-5	06/09	1												<0.020
G-6 R	06/09	1												<0.020
G-7	06/09	1												<0.020
G-8	06/09	1												<0.020
G-9	06/09	1												<0.020
G3_01	07/20	1												<0.030
G3_01	07/20	2												<0.030
G3_02	07/20	1												<0.030
Pajarito Canyon:														
Twomile at SR-501	03/31	D	<2.0	2,436	0.8	<3	26.5	<0.1	<0.9	<1.0	<1.3	2.4	4,354	
Twomile at SR-501	03/31	1												<0.030
Pajarito at SR-501	03/31	D	<2.0	4,073	1.8	<3	43.3	0.1	<0.9	6.7	5.4	<1.0	12,562	
Pajarito at SR-501	03/31	1												<0.030
Pajarito at SR-4	04/15	1	<2.0	4,506	9.0	<3	32.1	0.3	<0.9	1.2	3.2	2.0	6,484	<0.050
Potrillo Canyon:														
Potrillo at SR-4	05/24	D	<0.4	2,964	0.5	<1	39.3	0.3	<0.2	1.6	2.7	2.3	5,438	
Potrillo at SR-4	03/31	1												<0.030
Fence Canyon:														
Fence at SR-4	04/15	1	<2.0	2,122	0.7	<3	16.9	0.1	<0.9	<1.0	<0.9	<1.0	2,559	<0.050
Cañon de Valle:														
Cañon de Valle at SR-501	06/08	1												<0.020

Table 5-14. Total Recoverable Trace Metals in Sediments for 1999 (mg/kg[a]) (Cont.)

Station Name	Date	Code[b]	Ag	Al	As	B	Ba	Be	Cd	Co	Cr	Cu	Fe	Hg
Water Canyon:														
Water at SR-501	06/08	1												<0.020
Water at SR-4	03/31	D	<2.0	2,906	0.6	<3	53.0	0.1	<0.9	<1.0	<1.7	<1.0	5,830	
Water at SR-4	03/31	1												<0.030
Indio Canyon:														
Indio at SR-4	03/31	D	<2.0	3,055	0.6	<3	20.2	0.1	<0.9	<1.0	1.6	<1.0	4,411	
Indio at SR-4	03/31	1												<0.030
Ancho Canyon:														
Ancho at SR-4	03/31	2												<0.030
Ancho at SR-4	03/31	1												<0.030
Ancho at SR-4	03/31	D	<2.0	5,953	1.2	<3	49.5	0.2	<0.9	<1.6	6.7	2.4	6,100	
TA-49, Area AB:														
AB-1	06/08	1												<0.020
AB-1	06/08	2												<0.020
AB-2	06/08	1												<0.020
AB-3	06/08	1												<0.020
AB-4	06/08	1												<0.020
AB-4A	06/08	1												<0.020
AB-5	06/08	1												<0.020
AB-6	06/08	1												<0.020
AB-7	06/08	1												<0.020
AB-8	06/08	1												<0.020
AB-9	06/08	1												<0.020
AB-10	06/08	1												<0.020
AB-11	06/08	1												<0.020
White Rock, Cañada del Buey:														
Site #1 Bonnie View	10/28	1	<0.4	4,400	1.0	<1	77.8	0.5	<0.2	3.5	3.0	3.6	5,178	0.010
Site #2 Rover	10/28	1	<0.4	2,582	0.7	<1	50.9	0.3	<0.2	2.5	2.3	2.4	3,539	0.010
Site #3 Lejano	10/28	1												<0.010
Site #4 Meadow Lane	10/28	1												<0.010

Table 5-14. Total Recoverable Trace Metals in Sediments for 1999 (mg/kg[a]) (Cont.)

Station Name	Date	Code[b]	Ag	Al	As	B	Ba	Be	Cd	Co	Cr	Cu	Fe	Hg
Special EPA Sampling														
Ancho Canyon 1	12/16	1	<0.4	7,103	1.1	<1	69.1	0.5	0.5	2.6	10.4	9.1	8,232	0.227
Ancho Canyon 2	12/16	1	<0.4	7,757	1.0	<1	65.8	0.5	0.5	2.7	6.4	7.0	8,805	0.042
Ancho Canyon 3	12/16	1	<0.4	9,813	1.1	<1	72.8	0.6	0.5	3.0	7.7	6.6	10,041	0.048
Ancho Canyon 4	12/16	1	<0.4	4,138	0.8	<1	47.5	0.4	0.6	2.4	4.1	4.6	6,542	0.042
Ancho Canyon 5	12/16	1	0.6	3,442	0.7	<1	42.5	0.3	<0.4	2.0	3.5	3.7	4,792	0.054
Bayo Canyon 1	12/13	1	<0.4	6,266	1.7	<1	47.5	0.6	<0.2	2.2	5.2	6.5	7,915	0.030
Bayo Canyon 2	12/13	1	<0.4	6,175	1.4	<1	38.5	0.5	<0.4	1.5	4.8	3.3	7,858	0.030
Bayo Canyon 3	12/13	1	<0.4	4,396	1.1	<1	33.6	0.5	<0.2	1.5	3.0	2.7	6,296	0.020
Bayo Canyon 4	12/13	1	<0.4	2,537	1.1	<1	30.1	0.4	0.3	1.5	2.4	2.7	4,673	0.020
Cañada del Buey 1	12/15	1	<0.4	9,805	1.7	<1	97.0	0.7	<0.2	3.9	8.0	4.9	10,264	<0.010
Cañada del Buey 2	12/15	1	<0.4	11,681	2.4	<1	120.5	0.8	<0.4	4.6	10.1	6.0	11,251	<0.010
Cañada del Buey 3	12/16	1	<0.4	3,876	1.2	<1	49.6	0.3	<0.2	3.4	3.8	1.8	6,495	<0.010
Cañada del Buey 4	12/15	1	<0.4	8,758	2.0	<1	90.1	0.6	<0.2	4.1	7.5	3.3	9,027	<0.010
Cañada del Buey 4	12/15	2	<0.4	6,895	1.7	<1	88.6	0.6	<0.2	3.8	5.8	3.2	8,082	<0.010
Cañada del Buey 5A	12/15	1	<0.4	5,249	1.8	<1	79.8	0.5	<0.3	3.0	4.2	3.7	5,933	0.020
Cañada del Buey 5B	12/16	1	<0.4	1,118	0.4	<1	55.5	0.3	<0.2	2.1	1.2	1.8	845	<0.010
Cañada del Buey 6	12/15	1	<0.4	5,791	1.5	<1	94.8	0.6	<0.2	4.3	5.0	3.9	6,613	0.010
Cañada del Buey 7	12/15	1	<0.4	1,517	0.4	<1	66.6	0.4	<0.2	2.5	1.6	2.9	1,066	<0.010
Cañada del Buey 8	12/15	1	<0.4	10,626	1.7	<1	120.4	0.7	0.3	4.4	8.6	4.4	10,585	0.010
Mortandad Canyon 1	12/14	1	<0.4	7,810	1.7	<1	58.6	0.6	<0.2	2.7	5.3	4.3	7,675	0.020
Mortandad Canyon 2	12/14	1	<0.4	3,853	1.3	<1	40.5	0.4	<0.2	1.8	2.5	2.5	5,021	0.030
Mortandad Canyon 3	12/14	1	<0.4	5,938	1.4	<1	44.3	0.4	<0.2	2.1	5.3	2.0	6,620	0.030
Mortandad Canyon 4	12/14	1	<0.4	2,545	0.8	<1	29.1	0.3	<0.2	<2.0	2.6	1.8	6,684	0.030
Mortandad Canyon 5A	12/14	1	<0.4	5,746	1.6	<1	60.4	0.5	<0.2	2.2	4.1	3.4	6,981	0.060
Mortandad Canyon 5B	12/14	1	<0.4	4,719	1.0	<1	34.5	0.4	<0.2	1.3	3.0	1.7	5,599	0.010
Pajarito Canyon 1	12/16	1	<0.4	10,733	1.5	<1	134.9	0.8	0.6	5.7	8.7	9.1	11,658	0.018
Pajarito Canyon 2	12/16	1	<0.4	10,273	1.4	<1	100.8	0.6	<0.2	4.5	7.7	5.1	11,002	0.010
Pajarito Canyon 3	12/16	1	0.7	21,513	3.0	1	152.8	1.1	<0.6	5.4	17.7	11.1	16,563	0.020
Pajarito Canyon 4	12/16	1	<0.4	10,967	2.2	<1	133.3	0.8	<0.4	4.4	8.8	8.2	11,797	0.012
Sandia Canyon 1	12/13	1	<0.4	7,884	1.8	<1	73.9	0.7	<0.3	2.5	5.3	3.6	8,382	0.010
Sandia Canyon 2	12/13	1	<0.4	4,853	1.3	<1	56.3	0.7	<0.2	1.9	5.5	3.4	5,757	<0.010
Sandia Canyon 4	12/13	1	<0.5	6,916	1.7	<1	52.7	0.6	<0.2	2.3	19.4	5.2	8,121	0.020
Sandia Canyon 3	12/13	1	<0.4	6,091	1.3	<1	47.0	0.5	<0.2	2.3	15.5	6.2	7,789	0.020
Sandia Canyon 5	12/13	1	<0.4	9,119	2.1	<1	66.4	0.7	<0.2	2.7	27.9	8.0	9,184	0.060
Sandia Canyon 6	12/13	1	0.7	8,971	1.8	<1	61.4	0.6	<0.2	2.6	16.0	19.1	9,937	0.030

Table 5-14. Total Recoverable Trace Metals in Sediments for 1999 (mg/kg[a]) (Cont.)

Station Name	Date	Code[b]	Ag	Al	As	B	Ba	Be	Cd	Co	Cr	Cu	Fe	Hg
Standardized Comparisons														
Average Detection Limits			2	7	0.2	3	0.2	0.2	0.9	1.0	0.9	1.0	1	0.050
SAL[c]			380	78,000	19	5,900	270		38	4,600	30[d]	28,000		23

Table 5-14. Total Recoverable Trace Metals in Sediments for 1999 (mg/kg[a]) (Cont.)

Station Name	Date	Code[b]	Mn	Mo	Ni	Pb	Sb	Se	Sn	Sr	Ti	V	Zn
Regional Stations													
Rio Grande at Frijoles (bank)	12/21	1	154	<1.0	<6	5.6	<0.5	1.0	<4	40.2	<0.3	14.4	21.6
Rio Grande at Cochiti Spillway	09/23	1	213	<1.0	<14	6.5	<0.5	0.5	<4	77.0	<0.3	15.2	29.5
Reservoirs on Rio Chama (New Mexico)													
Heron Upper	08/31	1	464	<1.0	14	14.0	<0.5	1.3	<4	77.2	0.5	50.1	69.5
Heron Middle	08/31	1	257	<1.0	16	17.0	<0.5	1.2	<4	41.2	1.1	51.2	47.5
Heron Lower	08/31	1	538	<1.0	<31	11.0	<0.5	1.4	<4	209.0	0.3	60.6	97.1
Abiquiu Upper	08/30	1	429	<1.0	28	35.0	<0.5	0.7	<4	114.1	1.9	80.7	93.8
Abiquiu Middle	10/12	1	450	<1.0	14	29.0	<2.0	<3.0	<4	102.0	0.6	39.7	69.5
Abiquiu Lower	10/12	1	157	<1.0	<11	19.0	<0.5	<3.0	<4	38.5	<0.3	22.2	23.9
Reservoirs on Rio Grande (New Mexico)													
Cochiti Upper	10/13	1	711	<1.0	13	22.0	<0.5	<0.8	<4	147.2	0.4	42.1	94.2
Cochiti Middle	10/13	1	708	<1.0	<14	16.0	<0.5	<1.0	<4	185.2	<0.3	22.9	69.0
Cochiti Middle	10/13	2	707	<1.0	<28	19.7	<0.5	<1.0	<4	196.6	0.3	34.6	78.9
Cochiti Lower	10/13	1	822	<1.0	8	18.0	<0.5	440.0	<4	185.5	<0.3	29.0	74.6
Other Reservoirs (New Mexico)													
Guaje Reservoir	11/16	1	304	<1.0	<2	11.9	<0.5	3.0	<4	34.9	<0.3	19.0	56.6
Acid/Pueblo Canyons:													
Acid Weir	04/27	1	227	<5.0	<2	150.0	<0.5	<0.3	<5	3.7	<0.3	5.5	42.7
Pueblo 1	04/27	1	203	<5.0	2	16.8	<0.5	<0.3	<5	2.9	<0.3	3.4	31.1
Pueblo 2	05/24	D	162	<1.0	<2	4.0	1.0	0.3	<4	4.1	<0.3	3.5	28.5
Hamilton Bend Spring	05/24	D	181	<1.0	<2	4.3	1.0	0.3	<4	8.0	<0.3	5.2	26.4
Pueblo 3	05/24	D	51	<1.0	<2	4.0	1.0	0.3	<4	4.6	<0.3	4.0	70.2
Pueblo at SR-502	08/04	1	18,563	7.8	<17	15.0	<0.5	<0.3	<4	72.0	<0.3	15.5	132.6
DP/Los Alamos Canyons:													
Los Alamos at Bridge	04/27	1	122	<5.0	<2	8.9	<0.5	<0.3	<5	7.0	<0.3	4.5	25.9
Los Alamos at Bridge	04/27	2	319	<5.0	<5	16.2	<0.5	<0.3	<5	16.4	<0.3	8.4	44.7
Los Alamos at LAO-1	04/23	1	159	<1.0	<2	12.0	<1.0	<0.3	<4	5.9	0.5	4.5	28.8

Table 5-14. Total Recoverable Trace Metals in Sediments for 1999 (mg/kg[a]) (Cont.)

Station Name	Date	Code[b]	Mn	Mo	Ni	Pb	Sb	Se	Sn	Sr	Ti	V	Zn
DP/Los Alamos Canyons: (Cont.)													
DPS-1	04/23	1	125	<1.0	<2	12.0	<0.5	<0.3	<4	2.9	<0.3	5.4	27.5
DPS-4	04/27	1	113	<5.0	<2	12.7	<0.5	<0.3	<5	4.6	<0.3	3.1	24.6
Los Alamos at Upper GS	04/23	1	218	3.2	<2	14.0	<0.5	<0.3	<4	8.0	<0.3	4.9	19.6
Los Alamos at LAO-3	04/23	1	151	<1.0	<2	7.0	<1.0	<0.3	<4	2.5	0.3	3.8	21.1
Los Alamos at LAO-4.5	04/23	1	92	<1.0	<2	8.0	<1.0	<0.3	<4	3.0	0.3	2.5	18.8
Los Alamos at SR-4	08/03	1	147	<1.0	2	7.7	<0.5	<0.3	<4	8.1	<0.3	4.7	30.0
Sandia Canyon:													
Sandia at SR-4	08/03	1	99	<1.0	<2	5.2	<0.5	<0.3	<4	4.4	<0.3	0.7	9.6
Mortandad Canyon:													
Mortandad near CMR Building	04/29	1	212	1.2	<2	10.4	<1.0	<0.3	<4	8.6	<0.3	6.1	71.9
Mortandad west of GS-1	04/29	1	401	1.0	<2	11.4	<1.0	<0.3	<4	16.9	<0.6	9.6	43.7
Mortandad at GS-1	04/29	1	236	1.1	6	11.4	<1.0	<0.3	<4	6.5	<0.3	3.5	33.4
Mortandad at MCO-5	04/29	2	315	1.6	<2	7.2	<1.0	<0.3	<4	2.7	<0.3	7.1	82.4
Mortandad at MCO-5	04/29	1	163	<1.0	<2	5.5	<1.0	<0.4	<4	1.9	<0.3	3.2	32.7
Mortandad at MCO-7	04/29	1	<153	<1.0	<2	3.9	<1.0	<0.3	<4	<2.0	<0.3	<4.9	<20.7
Mortandad at MCO-9	04/29	1	217	<1.0	<2	6.5	<1.0	<0.3	<4	2.9	<0.3	3.2	27.5
Mortandad at MCO-13 (A-5)	08/05	2	237	<1.0	<2	10.0	<0.5	<0.3	<4	7.6	<0.3	7.3	31.9
Mortandad at MCO-13 (A-5)	08/05	1	167	<1.0	<2	8.0	<0.5	<0.3	<4	5.9	<0.3	2.0	12.1
Mortandad at SR-4 (A-9)	08/05	1	292	<1.0	<2	12.0	<0.5	<0.3	<4	10.6	<0.3	9.6	38.3
Mortandad at SR-4 (A-9)	08/05	2	206	<1.0	<7	13.0	<0.5	<0.3	<4	7.7	<0.3	6.2	26.4
Mortandad at Rio Grande (A-11)	09/20	1	155	<1.0	5	4.2	<0.5	<0.4	<4	8.8	<0.3	6.6	12.8
Cañada del Buey:													
Cañada del Buey at SR-4	05/24	D	189	<1.0	<2	5.0	1.0	0.3	<4	5.2	<0.3	3.6	13.1
CDB_01	07/20	1											
CDB_02	07/20	2											
CDB_02	07/20	3											
CDB_02	07/20	1											

Table 5-14. Total Recoverable Trace Metals in Sediments for 1999 (mg/kg[a]) (Cont.)

Station Name	Date	Code[b]	Mn	Mo	Ni	Pb	Sb	Se	Sn	Sr	Ti	V	Zn
TA-54, Area G:													
G-0	04/14	1	250	<1.0	5	11.0	<0.5	<0.3	<4	19.0	<0.3	12.0	50.0
G-0	04/14	2	230	1.3	5	13.0	<0.5	<0.3	<4	18.0	<0.3	11.0	47.0
G-1	06/09	1											
G-2	06/09	1											
G-3	06/09	1											
G-4 R-1	04/14	1	200	1.0	4.5	14.0	<0.5	<0.3	<4	8.5	<0.3	8.4	31.0
G-4 R-2	04/14	1	200	<2.0	<5	8.7	<0.5	0.3	<4	10.0	<0.3	3.8	37.0
G-5	06/09	1											
G-6 R	06/09	1											
G-7	06/09	1											
G-8	06/09	1											
G-9	06/09	1											
G3_01	07/20	1											
G3_01	07/20	2											
G3_02	07/20	1											
Pajarito Canyon:													
Twomile at SR-501	03/31	D	205	<5.0	5	13.6	<0.5		<5	6.0	<0.3	4.0	19.9
Twomile at SR-501	03/31	1						11.0					
Pajarito at SR-501	03/31	D	461	<5.0	7	12.4	<0.5		<5	6.6	<0.3	16.8	38.8
Pajarito at SR-501	03/31	1						0.3					
Pajarito at SR-4	04/15	1	180	<5.0	<4	24.0	<0.5	0.5	<5	6.1	0.3	8.4	30.2
Potrillo Canyon:													
Potrillo at SR-4	05/24	D	197	<1.0	<2	5.0	1.0		<4	6.1	<0.3	5.3	23.0
Potrillo at SR-4	03/31	1						0.5					
Fence Canyon:													
Fence at SR-4	04/15	1	93	<5.0	<4	8.4	<0.5	<0.3	<5	2.8	<0.3	2.5	15.7
Cañon de Valle:													
Cañon de Valle at SR-501	06/08	1											

Table 5-14. Total Recoverable Trace Metals in Sediments for 1999 (mg/kg[a]) (Cont.)

Station Name	Date	Code[b]	Mn	Mo	Ni	Pb	Sb	Se	Sn	Sr	Ti	V	Zn
Water Canyon:													
Water at SR-501	06/08	1											
Water at SR-4	03/31	D	182	<5.0	5	7.0	<0.5		<5	4.3	<0.3	4.7	23.9
Water at SR-4	03/31	1						0.5					
Indio Canyon:													
Indio at SR-4	03/31	D	134	<5.0	4	7.4	<0.5		<5	3.6	<0.3	3.4	20.9
Indio at SR-4	03/31	1						0.4					
Ancho Canyon:													
Ancho at SR-4	03/31	2						0.6					
Ancho at SR-4	03/31	1						0.6					
Ancho at SR-4	03/31	D	164	<5.0	8	10.5	<0.5		<5	10.3	<0.3	5.6	23.2
TA-49, Area AB:													
AB-1	06/08	1											
AB-1	06/08	2											
AB-2	06/08	1											
AB-3	06/08	1											
AB-4	06/08	1											
AB-4A	06/08	1											
AB-5	06/08	1											
AB-6	06/08	1											
AB-7	06/08	1											
AB-8	06/08	1											
AB-9	06/08	1											
AB-10	06/08	1											
AB-11	06/08	1											
White Rock, Cañada del Buey:													
Site #1 Bonnie View	10/28	1	267	<1.0	7	9.9	<0.5	<0.3	<4	12.1	<0.3	5.9	21.7
Site #2 Rover	10/28	1	211	<1.0	3	6.8	<0.5	0.5	<4	8.2	<0.3	4.4	18.9
Site #3 Lejano	10/28	1											
Site #4 Meadow Lane	10/28	1											

Table 5-14. Total Recoverable Trace Metals in Sediments for 1999 (mg/kg[a]) (Cont.)

Station Name	Date	Code[b]	Mn	Mo	Ni	Pb	Sb	Se	Sn	Sr	Ti	V	Zn
Special EPA Sampling													
Ancho Canyon 1	12/16	1	243	<1.0	5	11.1	<0.5	<0.3	<4	13.9	<0.3	9.9	32.6
Ancho Canyon 2	12/16	1	240	<1.0	5	11.6	<0.5	<0.6	<4	14.8	<0.3	10.6	35.3
Ancho Canyon 3	12/16	1	254	<1.0	<2	11.3	<0.5	0.3	<4	16.4	<0.3	13.1	38.4
Ancho Canyon 4	12/16	1	187	<1.0	<2	9.2	<0.5	<0.3	<4	9.6	<0.3	6.9	33.4
Ancho Canyon 5	12/16	1	159	<1.0	<2	7.2	<0.5	<0.3	<4	8.3	<0.3	5.1	21.6
Bayo Canyon 1	12/13	1	239	<1.0	4	10.5	<0.5	0.5	<4	10.3	<0.3	9.3	35.8
Bayo Canyon 2	12/13	1	223	<1.0	<6	9.6	<0.5	0.4	<4	9.9	<0.3	8.8	38.2
Bayo Canyon 3	12/13	1	211	<1.0	<2	8.5	<0.5	0.4	<4	7.7	<0.3	6.2	30.8
Bayo Canyon 4	12/13	1	180	<1.0	<2	8.9	<0.5	0.3	<4	6.4	<0.3	4.7	20.3
Cañada del Buey 1	12/15	1	273	<1.0	<11	12.1	<0.5	0.8	<4	19.3	<0.3	15.1	37.6
Cañada del Buey 2	12/15	1	305	<1.0	4	22.9	<0.5	0.7	<4	30.6	<0.3	15.0	171.0
Cañada del Buey 3	12/16	1	272	<1.0	3	9.0	<0.5	0.7	<4	6.8	<0.3	8.1	32.1
Cañada del Buey 4	12/15	1	330	<1.0	4	10.4	<0.5	0.7	<4	15.4	<0.3	13.3	30.8
Cañada del Buey 4	12/15	2	314	<1.0	5	9.4	<0.5	0.6	<4	14.9	<0.3	10.7	27.6
Cañada del Buey 5A	12/15	1	255	<1.0	5	20.2	<0.5	0.7	<4	13.4	<0.3	7.2	28.4
Cañada del Buey 5B	12/16	1	181	<1.0	<2	19.1	<0.5	0.5	<4	9.5	<0.3	3.1	14.3
Cañada del Buey 6	12/15	1	302	<1.0	<9	14.0	<0.5	0.8	<4	16.5	<0.3	8.6	24.9
Cañada del Buey 7	12/15	1	202	<1.0	<4	9.3	<0.5	0.5	<4	11.4	<0.3	4.0	9.1
Cañada del Buey 8	12/15	1	337	<1.0	6	10.4	<0.5	0.8	<4	18.7	<0.3	16.2	33.8
Mortandad Canyon 1	12/14	1	260	<1.0	6	8.6	<0.5	0.5	<4	10.7	<0.3	9.8	34.4
Mortandad Canyon 2	12/14	1	223	<1.0	<2	7.8	<0.5	0.4	<4	7.6	<0.3	5.2	25.1
Mortandad Canyon 3	12/14	1	276	<1.0	<2	9.4	<0.5	0.4	<4	8.5	<0.3	8.1	34.0
Mortandad Canyon 4	12/14	1	277	<1.0	<2	6.2	<0.5	<0.3	<4	4.3	<0.3	6.0	38.4
Mortandad Canyon 5A	12/14	1	249	<1.0	<2	13.0	<0.5	0.3	<4	11.0	<0.3	8.0	31.6
Mortandad Canyon 5B	12/14	1	198	<1.0	<9	5.5	<0.5	<0.3	<4	7.0	<0.3	5.8	27.4
Pajarito Canyon 1	12/16	1	332	<1.0	7	17.0	<0.5	0.6	<4	27.1	<0.3	12.3	45.0
Pajarito Canyon 2	12/16	1	309	<1.0	5	10.6	<0.5	0.4	<4	18.2	<0.3	14.5	35.2
Pajarito Canyon 3	12/16	1	354	<1.0	9	21.7	<0.5	0.9	<4	33.0	<0.3	24.1	60.2
Pajarito Canyon 4	12/16	1	290	<1.0	9	20.0	<0.5	0.6	<4	32.3	<0.3	13.9	38.9
Sandia Canyon 1	12/13	1	274	<1.0	4	8.8	<0.5	0.5	<4	14.9	<0.3	9.9	41.9
Sandia Canyon 2	12/13	1	213	<1.0	4	11.0	<0.5	0.5	<4	10.4	<0.3	6.1	28.7
Sandia Canyon 4	12/13	1	296	<1.0	<5	19.0	<0.5	0.4	<4	10.4	<0.3	9.3	47.6
Sandia Canyon 3	12/13	1	276	<1.0	<2	20.3	<0.5	0.4	<4	9.4	<0.3	8.7	46.7
Sandia Canyon 5	12/13	1	298	<1.0	5	19.1	<0.5	0.5	<4	14.2	<0.3	11.7	50.1
Sandia Canyon 6	12/13	1	300	<1.0	<8	19.7	<0.5	0.5	<4	12.4	<0.3	12.2	56.1

Table 5-14. Total Recoverable Trace Metals in Sediments for 1999 (mg/kg[a]) (Cont.)

Station Name	Date	Code[b]	Mn	Mo	Ni	Pb	Sb	Se	Sn	Sr	Ti	V	Zn
Standardized Comparisons													
Average Detection Limits			0.3	5	4	0.3	0.30	0.2	5	0.2	0.3	1.3	0.8
SAL[c]			390	380	1,500	400	31	380		46,000	6	540	23,000

[a] Less than symbol (<) means measurement was below the specified limit of detection of the analytical method.
[b] Codes: 1–primary analysis; 2–secondary analysis; R–lab replicate; D–lab duplicate.
[c] Screening Action Level, Environmental Restoration Project, 1997; see text for details.
[d] SAL value for hexavalent chromium is listed; SAL value for trivalent or total chromium is 210 mg/kg.

Table 5-15. Number of Samples Collected for Each Suite of Organic Compounds in Sediments for 1999

		Organic Suite[a]		
Station Name	**Date**	**HE**	**PCB**	**Semivolatile**
Above Ancho Spring	09/21	1		
Ancho at SR-4	03/31		2	2
Ancho Canyon 1	12/16		1	
Ancho Canyon 2	12/16		1	
Ancho Canyon 3	12/16		1	
Ancho Canyon 4	12/16		1	
Ancho Canyon 5	12/16		1	
Bayo Canyon 1	12/13		1	
Bayo Canyon 2	12/13		1	
Bayo Canyon 3	12/13		1	
Bayo Canyon 4	12/13		1	
G-0	04/14		2	2
G-1	04/14		1	1
G-2	04/14		1	1
G-3	04/14		1	1
G-4 R-1	04/14		1	1
G-4 R-2	04/14		1	1
G-5	04/14		1	1
G-6 R	04/14		1	1
G-7	04/15		2	2
G-8	04/14		1	1
G-9	04/14		1	1
Mortandad Canyon 1	12/14		1	
Mortandad Canyon 2	12/14		1	
Mortandad Canyon 3	12/14		1	
Mortandad Canyon 4	12/14		1	
Mortandad Canyon 5A	12/14		1	
Mortandad Canyon 5B	12/14		1	
Pajarito at SR-4	04/15	1		
Pajarito Canyon 1	12/16		1	
Pajarito Canyon 2	12/16		1	
Pajarito Canyon 3	12/16		1	
Pajarito Canyon 4	12/16		1	
Rio Grande at Frijoles (bank)	12/21		1	1
Rio Grande at Otowi (bank)	08/03		1	1
Sandia at SR-4	08/03		1	1
Sandia Canyon 1	12/13		1	
Sandia Canyon 2	12/13		1	
Sandia Canyon 3	12/13		1	
Sandia Canyon 4	12/13		1	
Sandia Canyon 5	12/13		1	
Sandia Canyon 6	12/13		1	
Water at SR-4	03/31		1	1

[a] High explosives, polychlorinated biphenyls, and semivolatiles.

Table 5-16. Radiochemical Analyses of Groundwater for 1999 (pCi/L[a])

Station Name	Date	Code[b]	F/UF[c]	^{3}H		^{137}Cs		U (µg/L)		^{238}Pu		^{239,240}Pu		^{241}Am		Gross Alpha		Gross Beta		Gross Gamma	
Regional Aquifer Wells																							
Test Wells:																							
Test Well 1	05/27	1	UF	200	610	0.00	10.06	2.85	0.29	0.000	0.000	0.011	0.009	0.040	0.020	4.6	4.2	6.8	5.0	272	52
Test Well 1	05/27	1D	UF					3.10	0.30												
Test Well 2	08/11	1	UF	760	660	0.00	6.09	0.01	0.01	0.007	0.010	0.014	0.010	–0.016	0.012	0.4	0.9	2.9	2.0	41	51
Test Well 2	08/11	1D	UF					0.01	0.05												
Test Well 3	05/27	1	UF	–240	570	0.00	7.27	0.63	0.06	0.016	0.009	0.011	0.007	0.067	0.022	0.5	1.7	3.3	2.2	137	51
Test Well 3	05/27	1D	UF					0.53	0.05												
Test Well 4	05/27	1	UF	50	600	0.00	7.74	0.00	0.01	–0.002	0.006	–0.005	0.011	0.048	0.014	0.2	0.6	2.4	2.2	96	51
Test Well 4	05/27	1D	UF					–0.02	0.05												
Test Well 8	08/03	1	UF	930	670	–0.55	4.25	0.39	0.05	–0.004	0.006	0.010	0.007	0.065	0.024	0.8	1.1	3.3	2.3	23	50
Test Well 8	08/03	2	UF	860	660	–0.29	5.69	0.40	0.20	–0.005	0.004	0.007	0.004	0.011	0.005	0.9	1.1	1.9	2.2	91	51
Test Well DT–5A	08/11	1	UF	700	650	–0.31	6.04	0.37	0.04	–0.006	0.005	0.011	0.008	–0.018	0.014	0.7	1.0	1.8	1.7	107	51
Test Well DT–5A	08/11	1D	UF					0.20	0.05												
Test Well DT–9	06/02	1	UF	130	600	0.00	6.03	0.47	0.06	0.007	0.006	0.006	0.007	0.013	0.008	0.5	1.1	1.8	1.4	160	51
Test Well DT–9	06/02	1D	UF					0.46	0.05												
Test Well DT–10	06/03	1	UF	–120	580	0.00	8.54	0.90	0.10	0.007	0.006	0.011	0.008	0.021	0.013	1.1	1.2	1.6	1.4	58	50
Test Well DT–10	06/03	1D	UF					0.64	0.06												
Water Supply Wells:																					
O–1	06/09	1	UF	260	610	0.54	1.17	1.70	0.30	0.002	0.008	0.014	0.007	–0.007	0.005	1.7	1.4	4.4	2.6	80	50
O–4	03/09	1	UF	–140	610	–0.22	3.74	0.74	0.07	0.002	0.008	0.013	0.008	0.028	0.009	1.0	1.5	4.9	5.7	88	51
O–4	03/09	1D	UF					1.30	0.40												
O–4	12/13	1	UF					0.90	0.20												
PM–1	03/09	1	UF	–90	620	1.01	1.22	1.75	0.18	0.014	0.008	0.009	0.008	0.030	0.010	3.6	2.5	6.5	5.5	103	94
PM–1	12/13	1	UF					1.90	0.10												
PM–2	03/09	1	UF	130	630	1.12	0.95	0.32	0.03	0.006	0.006	0.009	0.008	–0.019	0.031	0.8	0.9	2.3	3.4	73	51
PM–3	03/09	1	UF	–90	620	0.00	7.27	0.88	0.09	0.006	0.007	0.027	0.011	–0.005	0.006	1.4	1.7	4.5	5.9	52	72
PM–4	03/26	1	UF			–0.70	1.05	0.71	0.08	0.001	0.012	0.016	0.008	2.400	5.000	0.6	0.4	1.9	0.5		
PM–4	03/29	1	UF					0.57	0.07												
PM–4	03/30	1	UF					0.52	0.06												
PM–4	06/09	1	UF	90	600	–2.47	11.37	0.44	0.05	0.009	0.007	0.018	0.009	0.000	0.002	0.9	1.1	2.8	2.2	49	50
PM–4	06/09	2	UF	340	620	–1.20	6.25	0.35	0.05	0.005	0.007	0.010	0.006	0.002	0.002	0.6	1.0	2.2	2.2	43	50
PM–5	03/09	1	UF	150	630	0.00	7.12	0.57	0.06	–0.003	0.012	0.013	0.012	0.009	0.006	0.9	1.2	6.2	4.6	17	50
G–1	03/09	1	UF	–150	610	–0.96	7.36	0.51	0.05	0.065	0.051	–0.024	0.027	0.038	0.016	1.3	1.3	3.0	4.0	–15	50
G–1	03/09	1D	UF					1.30	0.40												

Table 5-16. Radiochemical Analyses of Groundwater for 1999 (pCi/L[a]) (Cont.)

Station Name	Date	Code[b]	F/UF[c]	^{3}H		^{137}Cs		U (µg/L)		^{238}Pu		^{239,240}Pu		^{241}Am		Gross Alpha		Gross Beta		Gross Gamma	
Regional Aquifer Wells (Cont.)																					
Water Supply Wells: (Cont.)																					
G–2	03/09	1	UF	10	620	0.00	7.04	1.09	0.11	0.003	0.006	0.005	0.010	0.001	0.001	1.9	1.7	2.2	10.0	23	51
G–6	03/09	1	UF	–10	620	2.79	1.44	0.51	0.05	0.014	0.009	0.028	0.013	0.051	0.015	1.0	1.1	3.2	3.9	131	51
G–1A	03/09	1	UF	–260	600	–1.21	7.20	0.65	0.07	0.000	0.000	0.022	0.012	0.013	0.009	1.6	1.4	2.7	4.2	25	51
G–2A (GR–2)	11/30	1	UF	90	600	–0.85	6.87	0.39	0.05	0.008	0.008	0.006	0.006	–0.001	0.002	1.6	1.7	3.8	2.7	50	49
G–3A (GR–3)	11/30	1	UF	–100	590	–1.39	5.89	0.50	0.10	0.012	0.012	0.021	0.011	0.004	0.003	1.8	1.7	3.4	2.7	33	49
G–4A (GR–4)	06/09	1	UF	110	600	0.00	11.29	0.70	0.10	0.003	0.005	0.013	0.007	0.011	0.005	1.8	1.4	4.3	2.5	97	51
G–5A (GR–1)	11/30	1	UF	30	600	–0.63	5.07	0.59	0.05	0.010	0.012	–0.004	0.004	0.004	0.003	1.5	1.7	3.9	2.7	36	49
Regional Aquifer Springs																					
White Rock Canyon Group I:																					
Sandia Spring	09/20	1	F			–0.57	5.77	0.51	0.06	–0.006	0.007	0.004	0.006	0.020	0.012	0.5	1.6	3.5	2.4	353	50
Sandia Spring	09/20	1	UF	280	630																
Spring 3	09/20	1	F			0.00	3.61	1.52	0.09	0.001	0.009	0.001	0.005	0.008	0.010	2.2	1.7	3.9	2.5	44	48
Spring 3	09/20	1	UF	–80	600																
Spring 3AA	09/20	1	F			0.91	0.90	1.20	0.20	0.016	0.014	0.018	0.010	0.029	0.011	1.5	1.5	2.7	2.3	14	48
Spring 3AA	09/20	1	UF	30	610																
Spring 4A	09/21	1	F			0.00	5.48	0.90	0.10	0.002	0.005	0.003	0.007	0.071	0.032	1.8	1.6	2.9	2.3	70	49
Spring 4A	09/21	1	UF	–230	590																
Spring 5	09/21	1	F			0.00	9.51	0.51	0.05	0.008	0.007	0.015	0.014	–0.042	0.273	0.4	2.3	2.3	2.2	79	49
Spring 5	09/21	1	UF	–120	600																
Ancho Spring	09/21	1	F			0.00	3.16	0.23	0.05	0.006	0.013	–0.008	0.006	0.008	0.009	0.8	1.4	2.9	2.3	55	48
Ancho Spring	09/21	1	UF	–120	600																
White Rock Canyon Group II:																					
Spring 6A	09/21	1	F			–1.16	7.83	2.30	0.10	0.019	0.010	0.011	0.008	0.033	0.010	2.0	1.6	4.0	2.5	48	48
Spring 6A	09/21	1	UF	70	610																
Spring 7	09/21	1	F			0.09	0.80	0.50	0.10	–0.004	0.006	0.011	0.007	–0.012	0.019	0.9	1.4	4.2	2.5	91	49
Spring 7	09/21	1	UF	–50	600																
Spring 7	09/21	2	F			0.00	7.78	0.48	0.05	–0.004	0.006	0.019	0.014	–0.022	0.063	0.8	1.4	2.5	2.3	106	49
Spring 7	09/21	2	UF	–40	600																
Spring 8B	09/22	1	F			–0.42	4.34	0.16	0.05	0.006	0.006	0.013	0.009	–0.021	0.042	0.6	1.4	2.2	2.2	24	48
Spring 8B	09/22	1	UF	–40	610																
Spring 9	09/21	1	F			0.84	0.71			0.009	0.007	0.004	0.006	–0.022	0.179	0.7	1.4	2.0	2.2	93	49
Spring 9	09/22	1	F					0.53	0.08												
Spring 9	09/22	1	UF	–10	610																

Table 5-16. Radiochemical Analyses of Groundwater for 1999 (pCi/L[a]) (Cont.)

Station Name	Date	Code[b]	F/UF[c]	^{3}H		^{137}Cs		U (µg/L)		^{238}Pu		^{239,240}Pu		^{241}Am		Gross Alpha		Gross Beta		Gross Gamma	
Regional Aquifer Springs (Cont.)																					
White Rock Canyon Group III:																					
Spring 1	09/20	1	F			0.76	1.65	0.48	0.09	0.008	0.011	0.026	0.012	0.173	0.108	2.3	1.7	3.8	2.5	120	49
Spring 1	09/20	1	UF	–10	610																
Spring 2	09/20	1	F			1.17	0.91			–0.003	0.008	0.004	0.007	0.012	0.020	0.8	1.4	2.6	2.3	67	49
Spring 2	09/20	1	UF	–140	600			2.00	4.00												
White Rock Canyon Group IV:																					
La Mesita Spring	07/19	1	F			0.00	10.32	13.00	5.00	0.001	0.004	0.020	0.009	0.008	0.004	12.6	5.4	8.8	5.1	105	51
La Mesita Spring	07/19	1	UF	170	650																
Other Springs:																					
Sacred Spring	07/22	1	F			1.40	1.44	1.90	0.20	0.002	0.004	0.007	0.007	–0.007	0.006	1.2	1.0	2.9	2.0	127	51
Sacred Spring	07/22	1	UF	160	650																
Canyon Alluvial Groundwater Systems																					
Acid/Pueblo Canyons:																					
APCO–1	03/25	1	UF	150	600	0.15	0.74	0.28	0.03	0.006	0.009	0.057	0.017	0.026	0.009	2.5	2.8	24.6	8.2	45	51
APCO–1	03/25	1D	UF					0.63	0.05												
Cañada del Buey:																					
CDBO–6	06/30	1	UF	190	650	0.80	0.80	0.37	0.04	0.002	0.008	0.016	0.007	0.000	0.002	14.6	5.8	14.8	6.2	124	51
CDBO–6	06/30	1D	UF					0.30	5.00												
CDBO–7	10/06	1	UF	210	620	–0.49	5.68	0.08	0.05	0.020	0.014	0.017	0.012	0.011	0.013	0.5	0.6	3.3	2.7	40	49
DP/Los Alamos Canyons:																					
LAO–C	04/08	1	UF	260	630	–1.14	10.00	0.01	0.05	0.019	0.019	0.030	0.014	0.036	0.009	0.8	3.5	4.1	3.8	87	51
LAO–0.7	04/08	1	UF	210	630	0.00	12.18	0.09	0.05	–0.008	0.009	0.029	0.015	0.017	0.010	4.1	4.1	12.4	7.0	113	51
LAO–1	04/08	1	UF	260	630	1.66	1.71	0.02	0.05	–0.011	0.005	0.014	0.011	0.024	0.008	1.9	2.8	51.2	14.0	42	51
LAO–2	04/07	1	UF	0	610	–0.91	10.05	–0.01	0.05	0.023	0.015	0.038	0.017	0.054	0.014	1.7	2.5	44.8	12.4	34	51
LAO–3A	04/07	1	UF	130	620	2.83	1.65	0.09	0.05	0.022	0.028	–0.014	0.013	0.012	0.006	1.7	3.0	124.0	28.3	55	51
LAO–3A	04/07	2	UF	160	630	1.17	1.06	0.09	0.05	0.002	0.008	0.001	0.008	0.026	0.013	1.2	2.3	124.0	27.3	60	51
LAO–4	11/29	1	UF	230	610	–0.68	9.75	–0.15	0.05	0.011	0.008	0.029	0.012	0.030	0.015	1.3	1.7	7.1	3.3	111	49
LAO–4.5C	03/25	1	UF	120	600	0.91	0.64	0.10	0.01	0.001	0.006	0.024	0.012	0.023	0.007	0.4	1.8	1.3	1.5	28	51
LAO–4.5C	03/25	1D	UF					0.28	0.05												
LAO–5	03/25	1	UF	190	610	0.79	1.08	0.48	0.05	0.154	0.027	0.037	0.016	0.069	0.019	1.5	1.4	6.1	2.7	60	51

Table 5-16. Radiochemical Analyses of Groundwater for 1999 (pCi/L[a]) (Cont.)

Station Name	Date	Code[b]	F/UF[c]	^{3}H		^{137}Cs		U (µg/L)		^{238}Pu		^{239,240}Pu		^{241}Am		Gross Alpha		Gross Beta		Gross Gamma	
Canyon Alluvial Groundwater Systems (Cont.)																					
Mortandad Canyon:																					
MCO–3	04/16	1	UF	6,600	1,000	1.65	1.14	2.71	0.09	0.860	0.061	0.321	0.036	1.504	0.089	6.6	3.9	97.0	22.8	616	62
MCO–5	04/14	1	UF	29,300	1,900	0.00	7.55	3.40	0.20	0.027	0.011	0.031	0.012	0.381	0.047	5.2	4.7	184.0	42.7	818	82
MCO–6B	04/14	1	UF	28,600	1,900	0.57	0.86	3.50	0.30	0.026	0.014	0.024	0.011	0.410	0.037	4.5	4.5	160.0	38.1	136	51
MCO–7	04/13	1	UF	11,000	1,200	0.61	0.67	3.10	0.40	0.047	0.025	0.032	0.021	0.419	0.040	2.0	2.7	34.7	11.5	216	52
MCO–7.5	03/26	1	UF	11,100	1,200	0.16	1.05	1.70	0.05	0.171	0.023	0.020	0.008	0.030	0.009	1.5	1.4	6.7	2.9	51	51
MT–3	11/09	1	UF	80	600	–1.60	7.94	4.10	0.40	0.006	0.013	0.016	0.011	0.004	0.003	0.5	2.8	3.3	2.7	148	49
Pajarito Canyon:																					
PCO–1	03/26	1	UF	160	610	1.14	1.12	0.46	0.05	0.707	0.055	0.039	0.013	0.611	0.045	0.3	0.6	11.8	6.5	240	52
PCO–1	12/09	1	UF			1.30	0.78			0.023	0.014	0.025	0.011							98	49
Intermediate Perched Groundwater Systems																					
Pueblo/Los Alamos Canyon Area:																					
Test Well 2A	05/27	1	UF	1,320	690	–0.63	8.33	0.18	0.02	0.001	0.006	0.003	0.004	0.038	0.020	0.7	5.2	5.7	4.0	258	52
Test Well 2A	05/27	1D	UF					0.10	0.05												
Basalt Spring	07/19	1	F			–1.53	10.07	0.28	5.00	0.016	0.015	0.012	0.011	0.008	0.004	4.0	3.0	13.4	6.1	60	51
Basalt Spring	07/19	1	UF	130	640																
Perched Groundwater System in Volcanics:																					
Water Canyon Gallery	08/03	1	UF	720	660	–0.88	3.26	–0.01	0.06	–0.013	0.007	0.002	0.005	0.011	0.005	0.7	1.1	2.6	2.2	15	50
San Ildefonso Pueblo:																					
LA–5	07/22	1	UF	130	640	1.28	1.07	1.20	0.10	–0.005	0.003	0.000	0.006	0.014	0.006	1.5	1.4	3.6	2.4	33	50
Eastside Artesian Well	07/21	1	UF	860	660	1.12	1.12	–0.09	0.10	0.003	0.009	0.012	0.008	–0.014	0.014	–0.9	1.8	1.5	9.3	55	50
Pajarito Well (Pump 1)	07/20	1	UF	130	640	0.00	9.98	12.00	5.00	–0.004	0.003	0.005	0.004	0.024	0.014	18.9	12.3	17.7	15.7	93	51
Don Juan Playhouse Well	07/21	1	UF	840	660	1.08	0.76	13.40	0.60	–0.002	0.005	–0.005	0.009	0.024	0.009	13.6	5.5	9.4	4.9	63	50
New Community Well	07/20	1	UF	780	660	1.28	0.96	26.90	0.80	–0.003	0.003	0.013	0.007	0.019	0.008	21.2	7.3	13.5	5.9	111	51
Sanchez House Well	07/22	1	UF	–60	630	0.00	29.66	12.60	0.50	–0.008	0.003	0.008	0.005	–0.001	0.003	11.6	6.2	11.6	7.2	118	51
Limits of Detection				700		4		0.10		0.04		0.04		0.04		3		3		120	
Water Quality Standards[d]																					
DOE DCG for Public Dose				2,000,000		3,000		800		40		30		30		30		1,000			
DOE Drinking Water System DCG				80,000		120		30		1.6		1.2		1.2		1.2		40			
EPA Primary Drinking Water Standard				20,000				20								15					
EPA Screening Level																				50	
NMWQCC Groundwater Limit								5,000													

Table 5-16. Radiochemical Analyses of Groundwater for 1999 (pCi/L[a]) (Cont.)

Station Name	Date	Code[b]	F/UF[c]	^{3}H	^{137}Cs	U (µg/L)	^{238}Pu	^{239,240}Pu	^{241}Am	Gross Alpha	Gross Beta	Gross Gamma

[a]Except where noted. Two columns are listed: the first is the analytical result, and the second is the radioactive counting uncertainty (1 std dev). Radioactivity counting uncertainties may be less than the analytical method uncertainty.
[b]Codes: 1–primary analysis; R1–lab replicate; D1–lab duplicate.
[c]F/UF: F–filtered; UF–unfiltered.
[d]Standards given here for comparison only; see Appendix A.

Table 5-17. LANL and NMED Groundwater Strontium-90 Data for 1999
(LANL's 1999 strontium-90 data are not valid because of analytical laboratory problems; the data appear in this report for documentary purposes only.)

				Los Alamos					Los Alamos Low Level					New Mexico Environment Department				
Station Name	Date	Code[a]	F/UF[b]	Value	Uncertainty	Detection Limit	Units	Detect?	Value	Uncertainty	Detection Limit	Units	Detect?	Value	Uncertainty	Detection Limit	Units	Detect?
Regional Aquifer Wells																		
Test Wells:																		
Test Well 1	05/27	1	UF	20.57	1.16	0.31	pCi/L	Detect						0.20	0.30	4.90	pCi/L	ND
Test Well 1	06/03	1	UF						0.03	0.09	0.20	pCi/L	ND					
Test Well 2	08/11	1	F											2.70	1.60	3.00	pCi/L	ND
Test Well 2	08/11	1	UF	–2.63	0.57	1.05	pCi/L	ND[c]	–0.21	0.07	0.14	pCi/L	ND					
Test Well 3	05/27	1	UF	10.58	0.67	0.31	pCi/L	Detect						–0.06	0.29	0.52	pCi/L	ND
Test Well 3	06/03	1	UF						–0.12	0.06	0.12	pCi/L	ND					
Test Well 4	05/27	1	UF	18.59	1.07	0.31	pCi/L	Detect	–0.15	0.06	0.12	pCi/L	ND	–0.07	0.29	0.51	pCi/L	ND
Test Well 8	08/03	1	F											0.66	1.70	2.00	pCi/L	ND
Test Well 8	08/03	1	UF	0.74	0.20	0.36	pCi/L	Detect	0.05	0.04	0.08	pCi/L	ND					
Test Well 8	08/03	2	UF	0.24	0.18	0.37	pCi/L	ND	–0.01	0.04	0.08	pCi/L	ND					
Test Well DT–5A	06/03	1	UF						–0.09	0.06	0.14	pCi/L	ND					
Test Well DT–5A	08/11	1	UF	–0.04	0.21	0.47	pCi/L	ND										
Test Well DT–9	06/02	1	UF	10.18	0.64	0.30	pCi/L	Detect	–0.11	0.06	0.12	pCi/L	ND					
Test Well DT–10	06/03	1	UF	9.99	0.63	0.29	pCi/L	Detect										
Test Well DT–10	08/11	1	UF						–0.18	0.06	0.12	pCi/L	ND					
Water Supply Wells:																		
O–1	06/09	1	UF	0.77	0.17	0.30	pCi/L	Detect	0.08	0.11	0.24	pCi/L	ND	–0.11	0.41	0.75	pCi/L	ND
O–4	03/09	1	UF	0.84	0.24	0.66	pCi/L	Detect						<0.14		0.14	pCi/L	ND
O–4	06/08	1	UF						–0.12	0.08	0.18	pCi/L	ND					
O–4	12/13	1	UF	–0.72	0.23	0.45	pCi/L	ND										
PM–1	03/09	1	UF	0.31	0.25	0.77	pCi/L	ND						1.14	0.23	0.15	pCi/L	Detect
PM–1	06/08	1	UF						0.10	0.05	0.10	pCi/L	ND					
PM–1	12/13	1	UF	–0.75	0.22	0.44	pCi/L	ND										
PM–2	03/09	1	UF	0.31	0.29	0.89	pCi/L	ND						0.19	0.11	0.16	pCi/L	ND
PM–2	06/08	1	UF						0.16	0.07	0.14	pCi/L	ND					
PM–3	03/09	1	UF	0.46	0.25	0.75	pCi/L	ND						<0.14		0.14	pCi/L	ND
PM–3	06/08	1	UF						0.08	0.08	0.17	pCi/L	ND					
PM–4	03/26	1	UF	0.24	0.11	0.36	pCi/L	ND										
PM–4	03/26	1	UF	0.26	0.11	0.36	pCi/L	ND										
PM–4	03/29	1	UF	–0.05	0.09	0.32	pCi/L	ND										
PM–4	03/29	1	UF	0.06	0.10	0.34	pCi/L	ND										
PM–4	03/30	1	UF	0.14	0.10	0.34	pCi/L	ND										
PM–4	06/09	1	UF	1.03	0.18	0.30	pCi/L	Detect	0.08	0.04	0.09	pCi/L	ND	0.30	0.41	0.67	pCi/L	ND
PM–4	06/09	2	UF	2.27	0.23	0.26	pCi/L	Detect	–0.02	0.04	0.09	pCi/L	ND	0.30	0.41	0.67	pCi/L	ND

Table 5-17. LANL and NMED Groundwater Strontium-90 Data for 1999 (Cont.)
(LANL's 1999 strontium-90 data are not valid because of analytical laboratory problems; the data appear in this report for documentary purposes only.)

				Los Alamos					Los Alamos Low Level					New Mexico Environment Department				
Station Name	Date	Code[a]	F/UF[b]	Value	Uncertainty	Detection Limit	Units	Detect?	Value	Uncertainty	Detection Limit	Units	Detect?	Value	Uncertainty	Detection Limit	Units	Detect?
Regional Aquifer Wells (Cont.)																		
Water Supply Wells: (Cont.)																		
PM–5	03/09	1	UF	0.76	0.29	0.83	pCi/L	ND						<0.15		0.15	pCi/L	ND
PM–5	06/09	1	UF						0.12	0.05	0.09	pCi/L	ND					
G–1	03/09	1	UF	1.23	0.33	0.87	pCi/L	Detect						<0.16		0.16	pCi/L	ND
G–2	03/09	1	UF	1.01	0.37	1.06	pCi/L	ND						<0.15		0.15	pCi/L	ND
G–2	06/08	1	UF						–0.04	0.05	0.12	pCi/L	ND					
G–6	03/09	1	UF	0.14	0.34	1.09	pCi/L	ND						<0.14		0.14	pCi/L	ND
G–6	06/08	1	UF						–0.15	0.07	0.15	pCi/L	ND					
G–1A	03/09	1	UF	0.47	0.30	0.89	pCi/L	ND						<0.16		0.16	pCi/L	ND
G–1A	06/08	1	UF						–0.02	0.05	0.10	pCi/L	ND					
G5A	11/30	1	UF						–0.10	0.16	0.35	pCi/L	ND					
G2A	11/30	1	UF	–0.40	0.16	0.33	pCi/L	ND										
G3A	11/30	1	UF	–0.26	0.16	0.33	pCi/L	ND										
G4A	06/09	1	UF	0.88	0.17	0.29	pCi/L	Detect	–0.01	0.06	0.14	pCi/L	ND	0.08	0.38	0.66	pCi/L	ND
G4A	06/09	2	UF						–0.30	0.10	0.21	pCi/L	ND	0.08	0.38	0.66	pCi/L	ND
Regional Aquifer Springs																		
White Rock Canyon Group I:																		
Sandia Spring	08/06	1	F											<0.52		0.52	pCi/L	ND
Sandia Spring	09/20	1	F	0.07	0.17	0.39	pCi/L	ND						–0.48	1.40	2.00	pCi/L	ND
Spring 3	09/20	1	F	–0.76	0.24	0.48	pCi/L	ND										
Spring 3AA	09/20	1	F	0.08	0.21	0.46	pCi/L	ND										
Spring 4A	09/21	1	F	–0.28	0.21	0.44	pCi/L	ND										
Spring 5	05/11	1	UF											<1.00	0.40	0.10	pCi/L	ND
Spring 5	09/21	1	F	–0.14	0.21	0.47	pCi/L	ND										
Ancho Spring	05/13	1	UF											<0.10	0.40	0.10	pCi/L	ND
Ancho Spring	09/21	1	F	0.34	0.28	0.60	pCi/L	ND						0.07	1.30	2.00	pCi/L	ND
White Rock Canyon Group II:																		
Spring 6	05/13	1	UF											<0.10	0.40	0.10	pCi/L	ND
Spring 6A	09/21	1	F	0.35	0.21	0.43	pCi/L	ND						–0.70	1.40	3.00	pCi/L	ND
Spring 7	09/21	1	F	–0.20	0.21	0.46	pCi/L	ND										
Spring 7	09/21	2	F	0.12	0.30	0.66	pCi/L	ND										
Spring 8B	09/22	1	F	0.80	0.20	0.36	pCi/L	Detect										
Spring 9	09/21	1	F	–0.33	0.51	1.13	pCi/L	ND						1.90	1.30	2.00	pCi/L	ND
Spring 9A	05/18	1	UF											<1.00	0.40	1.00	pCi/L	ND

Table 5-17. LANL and NMED Groundwater Strontium-90 Data for 1999 (Cont.)
(LANL's 1999 strontium-90 data are not valid because of analytical laboratory problems; the data appear in this report for documentary purposes only.)

				Los Alamos					Los Alamos Low Level					New Mexico Environment Department				
Station Name	Date	Code[a]	F/UF[b]	Value	Uncertainty	Detection Limit	Units	Detect?	Value	Uncertainty	Detection Limit	Units	Detect?	Value	Uncertainty	Detection Limit	Units	Detect?
Regional Aquifer Springs (Cont.)																		
White Rock Canyon Group III:																		
Spring 1	09/20	1	F	0.46	0.37	0.80	pCi/L	ND						–0.78	1.30	2.00	pCi/L	ND
Spring 2	09/20	1	F	–0.58	0.27	0.56	pCi/L	ND										
White Rock Canyon Group IV:																		
La Mesita Spring	07/19	1	F	0.40	0.18	0.35	pCi/L	ND										
Other Springs:																		
Sacred Spring	07/22	1	F	0.76	0.17	0.31	pCi/L	Detect						1.10	1.60	2.00	pCi/L	ND
Canyon Alluvial Groundwater Systems																		
Acid/Pueblo Canyons:																		
APCO–1	03/25	1	F											0.00	0.80	0.90	pCi/L	ND
APCO–1	03/25	1	UF	0.08	0.16	0.36	pCi/L	ND										
Cañada del Buey:																		
CDBO–6	06/30	1	UF	4.71	0.36	0.28	pCi/L	Detect						–0.12	0.29	0.52	pCi/L	ND
CDBO–7	10/06	1	UF	0.06	0.34	0.77	pCi/L	ND										
DP/Los Alamos Canyons:																		
LAO–C	04/08	1	UF	1.49	0.21	0.31	pCi/L	Detect										
LAO–0.7	04/08	1	UF	7.30	0.53	0.38	pCi/L	Detect										
LAO–1	04/08	1	UF	18.23	1.05	0.31	pCi/L	Detect										
LAO–2	04/07	1	UF	18.61	1.04	0.26	pCi/L	Detect						17.80	1.20	1.00	pCi/L	Detect
LAO–3A	04/07	1	UF	46.48	2.40	0.23	pCi/L	Detect										
LAO–3A	04/07	2	UF	44.95	2.48	0.55	pCi/L	Detect										
LAO–4	11/29	1	UF	2.15	0.42	0.68	pCi/L	Detect										
LAO–4.5C	03/25	1	UF	1.48	0.21	0.32	pCi/L	Detect										
LAO–5	03/25	1	UF	0.98	0.20	0.34	pCi/L	Detect										
Mortandad Canyon:																		
MT–3	11/09	1	UF	–1.00	0.49	1.01	pCi/L	ND										
MCO–3	04/16	1	UF	28.91	1.62	0.38	pCi/L	Detect						15.50	2.90	0.68	pCi/L	Detect
MCO–3	04/16	1	F											16.50	3.00	0.68	pCi/L	Detect
MCO–5	04/14	1	UF	62.58	3.30	0.42	pCi/L	Detect										

Table 5-17. LANL and NMED Groundwater Strontium-90 Data for 1999 (Cont.)
(LANL's 1999 strontium-90 data are not valid because of analytical laboratory problems; the data appear in this report for documentary purposes only.)

				Los Alamos					Los Alamos Low Level					New Mexico Environment Department				
Station Name	Date	Code[a]	F/UF[b]	Value	Uncertainty	Detection Limit	Units	Detect?	Value	Uncertainty	Detection Limit	Units	Detect?	Value	Uncertainty	Detection Limit	Units	Detect?
Canyon Alluvial Groundwater Systems (Cont.)																		
Mortandad Canyon: (Cont.)																		
MCO–5	04/15	1	F											40.10	7.30	0.68	pCi/L	Detect
MCO–6B	04/14	1	UF	51.64	2.74	0.39	pCi/L	Detect										
MCO–7	04/13	1	UF	1.00	0.21	0.34	pCi/L	Detect										
MCO–7.5	03/25	1	F											0.20	0.50	2.00	pCi/L	ND
MCO–7.5	03/26	1	UF	0.19	0.16	0.35	pCi/L	ND						0.00	0.80	0.90	pCi/L	ND
Pajarito Canyon:																		
PCO–1	03/26	1	UF	0.51	0.17	0.32	pCi/L	Detect										
Intermediate Perched Groundwater Systems																		
Pueblo/Los Alamos Canyon Area:																		
Test Well 2A	05/27	1	UF	19.03	1.08	0.30	pCi/L	Detect						0.23	0.33	0.54	pCi/L	ND
Basalt Spring	07/19	1	F	1.23	0.22	0.35	pCi/L	Detect						0.41	0.38	0.61	pCi/L	ND
Perched Groundwater System in Volcanics:																		
Water Canyon Gallery	08/03	1	UF	0.11	0.17	0.37	pCi/L	ND	–0.04	0.07	0.15	pCi/L	ND					
San Ildefonso Pueblo:																		
LA–5	07/22	1	UF	0.54	0.17	0.33	pCi/L	Detect						0.21	0.35	0.57	pCi/L	ND
Eastside Artesian Well	07/21	1	UF	0.98	0.17	0.29	pCi/L	Detect										
Pajarito Well (Pump 1)	07/20	1	UF	0.61	0.19	0.36	pCi/L	Detect										
Don Juan Playhouse Well	07/21	1	UF	1.13	0.18	0.28	pCi/L	Detect										
New Community Well	07/20	1	UF	0.32	0.14	0.28	pCi/L	ND										
Sanchez House Well	07/22	1	UF	24.09	1.37	0.37	pCi/L	Detect						–0.18	0.34	0.61	pCi/L	ND

[a] Codes: 1–primary analysis; 2–secondary analysis; R–lab replicate; D–lab duplicate.
[b] F/UF: F–filtered; UF–unfiltered.
[c] ND = not detected.

Table 5-18. Detections of Radionuclides[a] and Comparison to Department of Energy Derived Concentration Guides[b] in Groundwater for 1999

Station Name	Date	Code[c]	F/UF[d]	Analyte	Value	Uncertainty[e]	Detection Limit	Units	DOE DCG	Ratio of Value to DCG	Ratio of Value to Minimum Standard	Minimum Standard	Minimum Standard Type
APCO-1	03/25	1	UF	^{241}Am	0.026	0.009	0.025	pCi/L					
APCO-1	03/25	1	UF	^{239,240}Pu	0.057	0.017	0.035	pCi/L					
Don Juan Playhouse Well	07/21	1	UF	U	13.40	0.60		µg/L					
G-1A	03/09	1	UF	^{238}Pu	0.000	0.000	0.000	pCi/L					
G-6	03/09	1	UF	^{241}Am	0.051	0.015	0.039	pCi/L					
LAO-1	04/08	1	UF	Beta	51.2	14.0		pCi/L	1,000	0.05	1.02	50	EPA Screening Level
LAO-2	04/07	1	UF	^{241}Am	0.054	0.014	0.030	pCi/L					
LAO-2	04/07	1	UF	Beta	44.8	12.4		pCi/L					
LAO-3A	04/07	1	UF	Beta	124.0	28.3		pCi/L	1,000	0.12	2.48	50	EPA Screening Level
LAO-3A	04/07	1	UF	Beta	124.0	27.3		pCi/L	1,000	0.12	2.48	50	EPA Screening Level
LAO-4.5C	03/25	1	UF	^{241}Am	0.023	0.007	0.019	pCi/L					
LAO-5	03/25	1	UF	^{241}Am	0.069	0.019	0.053	pCi/L					
LAO-5	03/25	1	UF	^{238}Pu	0.154	0.027	0.051	pCi/L					
LAO-C	04/08	1	UF	^{241}Am	0.036	0.009	0.014	pCi/L					
MCO-3	04/16	1	UF	^{241}Am	1.504	0.089	0.048	pCi/L	30	0.05	1.25	1.2	DOE Drinking Water DCG
MCO-3	04/16	1	UF	Beta	97.0	22.8		pCi/L	1,000	0.10	1.94	50	EPA Screening Level
MCO-3	04/16	1	UF	Gamma	616	62	80	pCi/L					
MCO-3	04/16	1	UF	^{3}H	6,600	1,000	400	pCi/L					
MCO-3	04/16	1	UF	^{238}Pu	0.860	0.061	0.043	pCi/L					
MCO-3	04/16	1	UF	^{239,240}Pu	0.321	0.036	0.036	pCi/L					
MCO-5	04/14	1	UF	^{241}Am	0.381	0.047	0.038	pCi/L					
MCO-5	04/14	1	UF	Beta	184.0	42.7		pCi/L	1,000	0.18	3.68	50	EPA Screening Level
MCO-5	04/14	1	UF	Gamma	818	82	80	pCi/L					
MCO-5	04/14	1	UF	^{3}H	29,300	1,900	400	pCi/L	2,000,000	0.01	1.47	20,000	EPA Primary Drinking Water Standard
MCO-6B	04/14	1	UF	^{241}Am	0.410	0.037	0.044	pCi/L					
MCO-6B	04/14	1	UF	Beta	160.0	38.1		pCi/L	1,000	0.16	3.20	50	EPA Screening Level
MCO-6B	04/14	1	UF	^{3}H	28,600	1,900	400	pCi/L	2,000,000	0.01	1.43	20,000	EPA Primary Drinking Water Standard
MCO-7	04/13	1	UF	^{241}Am	0.419	0.040	0.018	pCi/L					
MCO-7	04/13	1	UF	Beta	34.7	11.5		pCi/L					
MCO-7	04/13	1	UF	Gamma	216	52	80	pCi/L					
MCO-7	04/13	1	UF	^{3}H	11,000	1,200	400	pCi/L					
MCO-7.5	03/26	1	UF	^{3}H	11,100	1,200	400	pCi/L					
MCO-7.5	03/26	1	UF	^{238}Pu	0.171	0.023	0.030	pCi/L					
MT-3	11/09	1	UF	Gamma	148	49	80	pCi/L					

Table 5-18. Detections of Radionuclides[a] and Comparison to Department of Energy Derived Concentration Guides[b] in Groundwater for 1999 (Cont.)

Station Name	Date	Code[c]	F/UF[d]	Analyte	Value	Uncertainty[e]	Detection Limit	Units	DOE DCG	Ratio of Value to DCG	Ratio of Value to Minimum Standard	Minimum Standard	Minimum Standard Type
New Community Well	07/20	1	UF	U	26.90	0.80		µg/L	800	0.03	1.34	20	Proposed EPA Primary Drinking Water Standard
PCO-1	03/26	1	UF	^{241}Am	0.611	0.045	0.047	pCi/L					
PCO-1	03/26	1	UF	Gamma	240	52	80	pCi/L					
PCO-1	03/26	1	UF	^{238}Pu	0.707	0.055	0.055	pCi/L					
PM-1	03/09	1	UF	^{241}Am	0.030	0.010	0.024	pCi/L					
Sanchez House Well	07/22	1	UF	U	12.60	0.50		µg/L					
Sandia Spring	09/20	1	F	Gamma	353	50	80	pCi/L					
Spring 6A	09/21	1	F	^{241}Am	0.033	0.010	0.025	pCi/L					
Test Well 1	05/27	1	UF	Gamma	272	52	80	pCi/L					
Test Well 2A	05/27	1	UF	Gamma	258	52	80	pCi/L					
Test Well 3	05/27	1	UF	^{241}Am	0.067	0.022	0.051	pCi/L					
Test Well 4	05/27	1	UF	^{241}Am	0.048	0.014	0.037	pCi/L					
Test Well DT-9	06/02	1	UF	Gamma	160	51	80	pCi/L					

[a] Detection defined as value ≥ 3× uncertainty and ≥ detection limit, except values shown for uranium ≥ 5 µg/L, for gross alpha ≥ 5 pCi/L, and for gross beta ≥ 20 pCi/L.
[b] Values indicated by entries in righthand columns are greater than the minimum standard shown. The minimum standard is either a DOE DCG for DOE-administered drinking water systems or an EPA drinking water standard.
[c] Codes: 1–primary analysis; 2–secondary analysis; R–lab replicate; D–lab duplicate.
[d] F/UF: F–filtered; UF–unfiltered.
[e] One standard deviation radioactivity counting uncertainty.

Table 5-19. Detections of Strontium-90[a] and Comparison to Department of Energy Derived Concentration Guides[b] in Groundwater Samples for 1999
(LANL's 1999 strontium-90 data are not valid because of analytical laboratory problems; the data appear in this report for documentary purposes only.)

Station Name	Date	Code[c]	F/UF[d]	Analyte	Value	Uncertainty[e]	Detection Limit	Units	DOE DCG	Ratio of Value to DCG	Ratio of Value to Minimum Standard	Minimum Standard	Minimum Standard Type
Basalt Spring	07/19	1	F	^{90}Sr	1.23	0.22	0.35	pCi/L					
CDBO-6	06/30	1	UF	^{90}Sr	4.71	0.36	0.28	pCi/L					
Don Juan Playhouse Well	07/21	1	UF	^{90}Sr	1.13	0.18	0.28	pCi/L					
Eastside Artesian Well	07/21	1	UF	^{90}Sr	0.98	0.17	0.29	pCi/L					
G-1	03/09	1	UF	^{90}Sr	1.23	0.33	0.87	pCi/L					
G-4A	06/09	1	UF	^{90}Sr	0.88	0.17	0.29	pCi/L					
LA-5	07/22	1	UF	^{90}Sr	0.54	0.17	0.33	pCi/L					
LAO-0.7	04/08	1	UF	^{90}Sr	7.30	0.53	0.38	pCi/L					
LAO-1	04/08	1	UF	^{90}Sr	18.23	1.05	0.31	pCi/L	1,000	0.02	2.28	8	EPA Primary Drinking Water Standard
LAO-2	04/07	1	UF	^{90}Sr	18.61	1.04	0.26	pCi/L	1,000	0.02	2.33	8	EPA Primary Drinking Water Standard
LAO-3A	04/07	1	UF	^{90}Sr	46.48	2.40	0.23	pCi/L	1,000	0.05	5.81	8	EPA Primary Drinking Water Standard
LAO-3A	04/07	1	UF	^{90}Sr	44.95	2.48	0.55	pCi/L	1,000	0.04	5.62	8	EPA Primary Drinking Water Standard
LAO-4	11/29	1	UF	^{90}Sr	2.15	0.42	0.68	pCi/L					
LAO-4.5C	03/25	1	UF	^{90}Sr	1.48	0.21	0.32	pCi/L					
LAO-5	03/25	1	UF	^{90}Sr	0.98	0.20	0.34	pCi/L					
LAO-C	04/08	1	UF	^{90}Sr	1.49	0.21	0.31	pCi/L					
MCO-3	04/16	1	UF	^{90}Sr	28.91	1.62	0.38	pCi/L	1,000	0.03	3.61	8	EPA Primary Drinking Water Standard
MCO-5	04/14	1	UF	^{90}Sr	62.58	3.30	0.42	pCi/L	1,000	0.06	7.82	8	EPA Primary Drinking Water Standard
MCO-6B	04/14	1	UF	^{90}Sr	51.64	2.74	0.39	pCi/L	1,000	0.05	6.45	8	EPA Primary Drinking Water Standard
MCO-7	04/13	1	UF	^{90}Sr	1.00	0.21	0.34	pCi/L					
O-1	06/09	1	UF	^{90}Sr	0.77	0.17	0.30	pCi/L					
O-4	03/09	1	UF	^{90}Sr	0.84	0.24	0.66	pCi/L					
Pajarito Well (Pump 1)	07/20	1	UF	^{90}Sr	0.61	0.19	0.36	pCi/L					
PCO-1	03/26	1	UF	^{90}Sr	0.51	0.17	0.32	pCi/L					
PM-4	06/09	1	UF	^{90}Sr	1.03	0.18	0.30	pCi/L					
PM-4	06/09	1	UF	^{90}Sr	2.27	0.23	0.26	pCi/L					
Sacred Spring	07/22	1	F	^{90}Sr	0.76	0.17	0.31	pCi/L					

Table 5-19. Detections of Strontium-90[a] and Comparison to Department of Energy Derived Concentration Guides[b] in Groundwater Samples for 1999 (Cont.)
(LANL's 1999 strontium-90 data are not valid because of analytical laboratory problems; the data appear in this report for documentary purposes only.)

Station Name	Date	Code[c]	F/UF[d]	Analyte	Value	Uncertainty[e]	Detection Limit	Units	DOE DCG	Ratio of Value to DCG	Ratio of Value to Minimum Standard	Minimum Standard	Minimum Standard Type
Sanchez House Well	07/22	1	UF	^{90}Sr	24.09	1.37	0.37	pCi/L	1,000	0.02	3.01	8	EPA Primary Drinking Water Standard
Spring 8B	09/22	1	F	^{90}Sr	0.80	0.20	0.36	pCi/L					
Test Well 1	05/27	1	UF	^{90}Sr	20.57	1.16	0.31	pCi/L	1,000	0.02	2.57	8	EPA Primary Drinking Water Standard
Test Well 2A	05/27	1	UF	^{90}Sr	19.03	1.08	0.30	pCi/L	1,000	0.02	2.38	8	EPA Primary Drinking Water Standard
Test Well 3	05/27	1	UF	^{90}Sr	10.58	0.67	0.31	pCi/L	1,000	0.01	1.32	8	EPA Primary Drinking Water Standard
Test Well 4	05/27	1	UF	^{90}Sr	18.59	1.07	0.31	pCi/L	1,000	0.02	2.32	8	EPA Primary Drinking Water Standard
Test Well 8	08/03	1	UF	^{90}Sr	0.74	0.20	0.36	pCi/L					
Test Well DT-10	06/03	1	UF	^{90}Sr	9.99	0.63	0.29	pCi/L	1,000	0.01	1.25	8	EPA Primary Drinking Water Standard
Test Well DT-9	06/02	1	UF	^{90}Sr	10.18	0.64	0.30	pCi/L	1,000	0.01	1.27	8	EPA Primary Drinking Water Standard

[a] Detection defined as value ≥ 3× uncertainty and ≥ detection limit, except values shown for uranium ≥ 5 µg/L, for gross alpha ≥ 5 pCi/L, and for gross beta ≥ 20 pCi/L.
[b] Values indicated by entries in righthand columns are greater than the minimum standard shown. The minimum standard is either a DOE DCG for DOE-administered drinking water systems or an EPA drinking water standard.
[c] Codes: 1–primary analysis; 2–secondary analysis; R–lab replicate; D–lab duplicate.
[d] F/UF: F–filtered; UF–unfiltered.
[e] One standard deviation radioactivity counting uncertainty.

Table 5-20. Chemical Quality of Groundwater for 1999 (mg/L[a])

Station Name	Date	Code[b]	F/UF[c]	SiO_2	Ca	Mg	K	Na	Cl	SO_4	CO_3 Alkalinity	Total Alkalinity	F	PO_4-P	NO_3-N	CN	TDS[d]	TSS[e]	Hardness as $CaCO_3$	pH[f]	Conductance (µS/cm)
Regional Aquifer Wells																					
Test Wells:																					
Test Well 1	05/27	1	UF	47					35.4	21.8	<5[g]	112	0.35	<0.03	5.82	0.01	304	2.8		7.9	419
Test Well 1	05/27	D	UF		50.4	10.0	2.9	16.8											167.0		
Test Well 2	08/11	1	UF	<1					2.0	<1.0	<5	67	0.54	<0.03	0.01	0.01	66	3		7.7	118
Test Well 2	08/11	D	UF		7.2	1.7	2.5	19.0										25.0			
Test Well 3	05/27	1	UF	80					3.0	3.0	<5	78	0.39	<0.03	0.61	0.01	180	<1		7.9	175
Test Well 3	05/27	D	UF		16.7	5.3	1.3	11.6											63.3		
Test Well 4	05/27	1	UF	6					2.1	<1.0	<5	68	0.17	<0.03	0.01	0.01	88	<1		8.2	129
Test Well 4	05/27	D	UF		9.2	5.1	1.2	9.8											44.1		
Test Well 8	08/03	1	UF	71	11.4	3.8	1.7	9.6	2.5	1.8	<5	61	0.20	<0.03	0.21	0.01	114	<1	44.0	7.8	124
Test Well 8	08/03	2	UF	70	11.6	3.8	2.1	9.7	2.9	1.9	<5	71	0.20	<0.03	0.20	0.01	130	<1	44.7	7.6	123
Test Well DT–5A	08/11	1	UF	75					2.0	1.3	<5	51	0.25	<0.03	0.32	0.01	118	<1		7.6	102
Test Well DT–5A	08/11	D	UF		9.1	2.4	2.4	10.0											32.6		
Test Well DT–9	06/02	1	UF	72					1.9	1.9	<5	57	0.28	<0.03	0.34	<0.01	134	1.2		7.9	116
Test Well DT–9	06/02	D	UF		10.3	2.7	<0.7	10.5											37.1		
Test Well DT–10	06/03	1	UF	67					1.8	1.7	<5	58	0.21	<0.03	0.24	<0.01	136	<1		8.1	130
Test Well DT–10	06/03	D	UF		12.2	3.5	<0.7	10.8											44.9		
Water Supply Wells:																					
O–1	06/09	1	UF	60	15.0	2.2	1.9	29.2	5.9	6.6	<5	99	0.35	0.07	1.33	0.03	184	<1	46.2	8.5	226
O–4	03/09	1	UF	93	18.5	7.8	<2.5	20.8	8.4	6.0	<5	114	0.28	0.04	0.45	<0.01	222	<1	78.4	7.3	255
PM–1	03/09	1	UF	77	24.6	6.0	<2.5	19.0	6.1	5.0	<5	115	0.24	0.02	0.54	<0.01	192	<1	86.1	8.1	248
PM–2	03/09	1	UF	90	8.6	2.9	<2.5	10.5	4.1	3.0	<5	54	0.25	0.03	0.34	<0.01	128	<1	33.4	7.9	116
PM–3	03/09	1	UF	94	22.7	7.5	<2.5	17.7	7.0	5.0	<5	109	0.28	0.02	0.47	<0.01	212	<1	87.5	7.8	248
PM–4	06/09	1	UF	84	11.0	3.7	1.7	11.1	2.3	2.6	<5	60	0.24	0.07	0.33	0.02	148	<1	42.7	8.0	135
PM–4	06/09	2	UF	85	10.7	3.6	1.6	11.1	2.3	2.3	<5	66	0.24	0.08	0.33	0.02	146	<1	41.7	8.0	138
PM–5	03/09	1	UF	91	11.8	4.5	<2.5	12.6	3.1	3.0	<5	68	0.26	<0.02	0.30	<0.01	150	<1	48.0	7.8	150
G–1	03/09	1	UF	81	12.3	0.5	<2.5	21.2	2.6	5.0	<5	70	0.40	<0.02	0.44	<0.01	154	<1	32.6	8.4	160
G–2	03/09	1	UF	72	0.9	0.1	<2.5	3.4	3.3	4.0	<5	100	0.97	<0.02	0.42	<0.01	176	<1	2.5	8.5	211
G–6	03/09	1	UF	67	16.4	3.4	<2.5	12.5	3.0	4.0	<5	77	0.24	<0.02	0.52	<0.01	152	<1	54.8	8.2	162
G–1A	03/09	1	UF	75	10.2	0.5	<2.5	30.0	3.6	5.0	<5	83	0.54	<0.02	0.45	<0.01	166	<1	27.3	8.4	181
G–2A (GR–2)	11/30	1	UF	61	10.8	0.8	2.2	24.4	2.1	3.2	<5	79	0.36	<0.03	0.41	0.03	156	<1	30.5	6.9	159
G–3A (GR–3)	11/30	1	UF	61	10.5	0.8	2.1	24.0	2.0	3.1	<5	80	0.36	0.04	0.42	0.03	150	<1	29.7	8.0	157
G–4A (GR–4)	06/09	1	UF	56	17.0	3.3	1.6	13.2	3.7	3.8	<5	77	0.22	0.06	0.50	0.02	120	<1	56.0	8.4	169
G–5A (GR–1)	11/30	1	UF	61	10.7	0.8	2.2	24.0	2.1	3.1	<5	78	0.36	<0.03	0.41	0.03	146	<1	30.1	8.3	155
Regional Aquifer Springs																					
White Rock Canyon Group I:																					
Sandia Spring	09/20	1	F	48	37.1	2.4	2.5	14.4	4.9	3.5	<5	136	0.54	<0.03	0.03		180		102.5	7.9	269
Sandia Spring	09/20	1	UF													0.01		561			

Table 5-20. Chemical Quality of Groundwater for 1999 (mg/L[a]) (Cont.)

Station Name	Date	Code[b]	F/UF[c]	SiO_2	Ca	Mg	K	Na	Cl	SO_4	CO_3 Alkalinity	Total Alkalinity	F	PO_4-P	NO_3-N	CN	TDS[d]	TSS[e]	Hardness as $CaCO_3$	pH[f]	Conductance (µS/cm)
Regional Aquifer Springs (Cont.)																					
White Rock Canyon Group I: (Cont.)																					
Spring 3	09/20	1	F	52	21.6	1.6	2.7	13.7	5.2	5.1	<5	135	0.43	<0.03	1.08		154		60.6	8.2	197
Spring 3	09/20	1	UF													0.01		11			
Spring 3AA	09/20	1	F	43	16.9	0.3	2.5	14.9	3.9	3.2	<5	83	0.39	<0.03	0.40		118		43.4	7.8	167
Spring 3AA	09/20	1	UF													0.01		167			
Spring 4A	09/21	1	F	71	18.4	4.1	1.8	10.6	6.1	5.2	<5	80	0.42	<0.03	0.86		124		62.9	8.1	186
Spring 4A	09/21	1	UF													0.01		<1			
Spring 5	09/21	1	F	70	17.9	4.3	2.1	10.4	5.1	4.5	<5	79	0.38	<0.03	0.65		130		62.2	8.2	179
Spring 5	09/21	1	UF													0.02		7			
Ancho Spring	09/21	1	F	76	12.7	2.9	1.8	9.0	3.5	2.1	<5	62	0.32	<0.03	0.36		98		43.6	7.7	136
Ancho Spring	09/21	1	UF													0.01		13			
White Rock Canyon Group II:																					
Spring 6A	09/21	1	F	68	20.8	3.4	2.6	25.1	4.6	7.5	<5	114	0.43	<0.03	0.33		196		66.1	7.2	245
Spring 6A	09/21	1	UF													0.01		8			
Spring 7	09/21	1	F	79	11.7	2.7	2.0	11.2	1.5	3.0	<5	65	0.29	0.03	0.41		144		40.3	7.4	142
Spring 7	09/21	2	F	79	12.3	2.8	2.0	11.9	2.8	2.9	<5	65	0.30	<0.03	0.59		150		42.5	7.4	143
Spring 7	09/21	1	UF													0.01		37			
Spring 7	09/21	2	UF													<0.01		144			
Spring 8B	09/22	1	F	81	11.1	3.1	1.9	10.8	3.1	1.8	<5	70	0.37	<0.03	0.07		106		40.4	7.6	132
Spring 8B	09/22	1	UF													0.01		<1			
Spring 9	09/22	1	F	79	10.8	2.9	<1.8	10.5	2.3	1.8	<5	61	0.39	<0.03	0.10		124		38.8	7.8	127
Spring 9	09/22	1	UF													0.01		156			
White Rock Canyon Group III:																					
Spring 1	09/20	1	F	34	15.4	0.9	1.8	26.3	4.8	6.5	<5	104	0.53	<0.03	0.35		218		42.0	8.0	217
Spring 1	09/20	1	UF													0.01		549			
Spring 2	09/20	1	F	36	19.3	1.0	1.5	40.7	4.0	5.3	<5	136	0.65	<0.03	0.01		194		38.8	8.4	277
Spring 2	09/20	1	UF															<1			
White Rock Canyon Group IV:																					
La Mesita Spring	07/19	1	F	30	36.2	1.1	2.2	27.7	6.9	13.9	<5	124	0.25	0.03	5.37		212		94.3	8.2	298
La Mesita Spring	07/19	1	UF													<0.01		<1			
Other Springs:																					
Sacred Spring	07/22	1	F	44	30.0	1.4	2.1	19.9	3.9	8.2	<5	109	0.43	<0.03	0.29		162		80.4	8.3	219
Sacred Spring	07/22	1	UF													<0.01		4			
Canyon Alluvial Groundwater Systems																					
Acid/Pueblo Canyons:																					
APCO–1	03/25	1	F	82	20.1	5.6	11.6	66.4	44.7	23.4	<5	142	0.48	4.65	4.07		382		73.1	7.0	502
APCO–1	03/25	1	UF													<0.01		<1			

Table 5-20. Chemical Quality of Groundwater for 1999 (mg/L[a]) (Cont.)

Station Name	Date	Code[b]	F/UF[c]	SiO_2	Ca	Mg	K	Na	Cl	SO_4	CO_3 Alkalinity	Total Alkalinity	F	PO_4-P	NO_3-N	CN	TDS[d]	TSS[e]	Hardness as $CaCO_3$	pH[f]	Conductance (µS/cm)
Canyon Alluvial Groundwater Systems (Cont.)																					
Cañada del Buey:																					
CDBO–6	06/30	1	F	57	15.6	3.4	2.0	18.9	19.0	9.0	<5	<5	0.18	0.20	0.12		200		53.1	1.7	11,600
CDBO–6	06/30	1	UF		15.0	3.5	2.0	20.0								<0.01		69	51.6		
CDBO–7	10/06	1	F	66	19.3	4.0	2.3	21.3	22.7	7.6	<5	74	0.13	0.15	0.01		164		64.8	8.0	233
CDBO–7	10/06	1	UF		19.5	4.1	2.8	21.6								0.02		<3			
DP/Los Alamos Canyons:																					
LAO–C	04/08	1	F	32	19.4	4.5	1.7	54.7	89.3	7.1	<5	60	0.11	0.03	0.06		272		67.0	7.0	418
LAO–C	04/08	1	UF		20.0	4.6	2.0	53.6								<0.01		<1			
LAO–0.7	04/08	1	F	30	19.1	3.8	1.4	50.9	86.8	6.6	<5	46	0.14	0.05	0.09		244		63.3	7.1	398
LAO–0.7	04/08	1	UF		19.6	3.8	1.7	49.6								<0.01		27			
LAO–1	04/08	1	F	38	16.3	3.4	1.7	34.7	53.3	5.7	<5	53	0.21	0.06	0.20		202		54.8	7.0	289
LAO–1	04/08	1	UF		16.7	3.3	2.1	34.6								<0.01		2			
LAO–2	04/07	1	F	41	22.2	5.6	4.5	33.7	70.7	7.2	<5	51	0.51	0.11	0.38		244		78.4	6.9	352
LAO–2	04/07	1	UF		21.4	5.5	4.2	33.9								<0.01		<1			
LAO–3A	04/07	1	F	59	32.4	6.8	5.8	35.5	81.5	10.4	<5	65	0.52	0.13	0.74		306		109.0	7.0	421
LAO–3A	04/07	2	F	59	32.4	6.9	5.6	36.3	82.6	10.4	<5	63	0.51	<0.03	0.74		304		109.3	7.0	421
LAO–3A	04/07	1	UF		31.1	6.6	5.1	35.6								<0.01		<1			
LAO–3A	04/07	2	UF		31.4	6.7	5.2	35.7								<0.01		<1			
LAO–4	11/29	1	F	42	11.5	3.3	4.0	25.4	21.2	9.5	<5	67	0.63	0.04	<0.01		152		42.1	7.0	209
LAO–4	11/29	1	UF													0.03		5			
LAO–4.5C	03/25	1	F	39	10.5	3.3	2.8	27.7	18.3	11.7	<5	63	0.64	0.02	0.01		162		39.8	6.9	208
LAO–4.5C	03/25	1	UF													<0.01		2			
LAO–5	03/25	1	F	42	9.0	3.17	<1.7	29.2	27.5	8.9	<5	54	0.44	0.02	<0.01		146		35.5	7.0	216
LAO–5	03/25	1	UF																		
Mortandad Canyon:																					
MCO–3	04/16	1	F	48	37.0	1.8	7.7	42.0	14.4	18.0	<5	139	2.22	0.19	8.02		308		99.8	7.5	412
MCO–3	04/16	1	UF													0.01		<1			
MCO–5	04/14	1	F	39					27.8	33.0	<5	170	1.07	0.07	32.90		530			7.2	756
MCO–5	04/14	1	UF													0.01		<1			
MCO–5	04/15	1	F		55.4	5.4	19.7	81.4											160.6		
MCO–6B	04/14	1	F	40	50.0	4.9	21.0	81.5	25.9	29.0	<5	166	1.18	0.09	30.90		504		145.2	7.3	712
MCO–6B	04/14	1	UF													0.01		<1			
MCO–7	04/13	1	F	40	19.0	4.9	16.3	71.2	14.8	16.0	<5	155	1.79	0.37	14.90		378		67.5	7.3	495
MCO–7	04/13	1	UF													0.01		11			
MCO–7.5	03/26	1	F	35	18.5	4.7	9.9	83.3	17.8	16.2	<5	160	1.75	0.08	16.00		366		65.5	7.1	527
MCO–7.5	03/26	1	UF													<0.01		2			
MT–3	11/09	1	F	66	17.7	3.8	3.1	20.3	18.8	7.1	<5	75	0.12	0.16	0.11		170		60.0	7.0	205
MT–3	11/09	1	UF		26.6	6.0	5.8	21.7								0.03		<1			

Table 5-20. Chemical Quality of Groundwater for 1999 (mg/L[a]) (Cont.)

Station Name	Date	Code[b]	F/UF[c]	SiO_2	Ca	Mg	K	Na	Cl	SO_4	CO_3 Alkalinity	Total Alkalinity	F	PO_4-P	NO_3-N	CN	TDS[d]	TSS[e]	Hardness as $CaCO_3$	pH[f]	Conductance (µS/cm)
Canyon Alluvial Groundwater Systems (Cont.)																					
Pajarito Canyon:																					
PCO–1	03/26	1	F	34	12.9	4.0	<1.7	18.5	17.5	7.8	<5	57	0.14	<0.02	0.07		142		48.8	6.7	186
PCO–1	03/26	1	UF													<0.01		<1			
Intermediate Perched Groundwater Systems																					
Pueblo/Los Alamos Canyon Area:																					
Test Well 2A	05/27	1	UF	23					46.2	24.8	<5	98	0.17	<0.03	0.38	0.01	254	8.8		8.0	390
Test Well 2A	05/27	D	UF		41.2	7.4	1.7	22.5											133.5		
Basalt Spring	07/19	1	F	64	21.9	5.3	7.7	51.3	35.3	21.0	<5	123	0.43	0.58	2.78		280		76.6	7.0	419
Basalt Spring	07/19	1	UF													<0.01		<1			
Perched Groundwater System in Volcanics:																					
Water Canyon Gallery	08/03	1	UF	46	6.9	3.1	1.7	5.1	<1.0	1.1	<5	44	0.05	<0.03	0.28	0.01	88	<1	30.3	8.0	77
San Ildefonso Pueblo:																					
LA–5	07/22	1	UF	41	22.6	0.8	1.9	15.9	3.2	5.4	<5	79	0.44	<0.03	0.58	0.01	146	<2	59.8	8.0	159
Eastside Artesian Well	07/21	1	UF	1	2.8	0.2	0.5	87.1	3.3	14.4	18	190	0.91	<0.03	0.01	<0.01	204	<1	7.6	9.0	400
Pajarito Well (Pump 1)	07/20	1	UF	36	49.6	4.7	4.0	282.6	182.0	47.7	<5	520	0.55	<0.03	0.30	0.01	920	<1	143.0	7.5	1,520
Don Juan Playhouse Well	07/21	1	UF	26	15.5	1.4	1.1	56.2	4.3	16.7	<5	147	0.49	<0.03	1.61	<0.01	212	<5	44.5	8.6	336
New Community Well	07/20	1	UF	27	17.9	1.0	0.8	80.1	8.1	36.3	<5	175	0.18	<0.03	1.58	<0.01	280	<1	48.8	8.3	443
Sanchez House Well	07/22	1	UF	40	31.9	2.1	<1.6	97.3	43.2	43.9	<5	196	1.20	<0.03	1.24	0.01	382	<2	88.4	8.5	546
Water Quality Standards[h]																					
EPA Primary Drinking Water Standard										500			4		10	0.2					
EPA Secondary Drinking Water Standard									250	250							500			6.8–8.5	
EPA Health Advisory								20													
NMWQCC Groundwater Limit									250	600			1.6		10	0.2	1,000			6–9	

[a] Except where noted.
[b] Codes: 1–primary analysis; 2–secondary analysis; R–lab replicate; D–lab duplicate.
[c] F/UF: F–filtered; UF–unfiltered.
[d] Total dissolved solids.
[e] Total suspended solids.
[f] Standard units.
[g] Less than symbol (<) means measurement was below the specified limit of detection of the analytical method.
[h] Standards given here for comparison only; see Appendix A.

Table 5-21. Trace Metals in Groundwater for 1999 (μg/L)

Station Name	Date	Code[a]	F/UF[b]	Ag	Al	As	B	Ba	Be	Cd	Co	Cr	Cu	Fe	Hg
Regional Aquifer Wells															
Test Wells:															
Test Well 1	05/27	1	UF												<0.1
Test Well 1	05/27	D	UF	<6[c]	<40	<2	80	76	<1	<3	<6	<5	<4	620	
Test Well 2	08/11	1	UF												<0.1
Test Well 2	08/11	D	UF	<6	<40	<3	<160	15	1	<3	7	<5	22	875	
Test Well 3	05/27	1	UF												<0.1
Test Well 3	05/27	D	UF	<6	<40	<2	57	24	<1	<3	<6	<5	<4	202	
Test Well 4	05/27	1	UF												<0.1
Test Well 4	05/27	D	UF	<6	<40	<2	11	41	<1	<3	<6	<5	7	928	
Test Well 8	08/03	1	UF	<6	63	<2	<19	8	1	<3	8	<5	<4	129	<0.1
Test Well 8	08/03	2	UF	<6	<40	<2	<9	7	1	<3	<6	<5	<4	111	<0.1
Test Well DT-5A	08/11	1	UF												<0.1
Test Well DT-5A	08/11	D	UF	<6	<40	<2	<160	22	<1	<3	<6	<5	<20	67	
Test Well DT-9	06/02	1	UF												<0.1
Test Well DT-9	06/02	D	UF	<6	141	<2	41	14	<1	<3	<6	5	<4	<30	
Test Well DT-10	06/03	1	UF												<0.1
Test Well DT-10	06/03	D	UF	<6	138	<2	34	5	<1	<3	<6	5	<4	<30	
Water Supply Wells:															
O-4	12/13	1	UF			<2									
PM-1	12/13	1	UF			<2									
G-2A (GR-2)	11/30	1	UF	<6	72	13	17	10	<1	<3	<6	<8	<4	<30	
G-3A (GR-3)	11/30	1	UF	<6	106	12	40	10	<1	<3	7	6	<4	<30	
G-5A (GR-1)	11/30	1	UF	<7	165	12	51	10	<1	<3	38	<5	<4	<30	
Regional Aquifer Springs															
White Rock Canyon Group I:															
Sandia Spring	09/20	1	F	<11	<72	<2	18	122	<1	<3	<6	<5	<10	<63	
Sandia Spring	09/20	1	UF												<0.1
Spring 3	09/20	1	F	11	<72	2	25	36	<1	<3	<6	<10	<10	<63	
Spring 3	09/20	1	UF												<0.1
Spring 3AA	09/20	1	F	<11	<72	<2	12	8	<1	<3	<6	<5	<10	<72	
Spring 3AA	09/20	1	UF												<0.1
Spring 4A	09/21	1	F	<11	<72	<5	24	41	<1	<3	<6	7	<10	<63	
Spring 4A	09/21	1	UF												<0.1
Spring 5	09/21	1	F	<11	<72	<2	15	25	<1	<3	11	<13	<10	<63	
Spring 5	09/21	1	UF												<0.1
Ancho Spring	09/21	1	F	<11	<72	<3	16	25	<1	<3	6	<5	<10	<63	
Ancho Spring	09/21	1	UF												<0.1

Table 5-21. Trace Metals in Groundwater for 1999 (µg/L) (Cont.) (Cont.)

Station Name	Date	Code[a]	F/UF[b]	Ag	Al	As	B	Ba	Be	Cd	Co	Cr	Cu	Fe	Hg
Regional Aquifer Springs (Cont.)															
White Rock Canyon Group II:															
Spring 6A	09/21	1	F	<11	<72	<2	29	34	<1	<3	<9	<5	<10	<63	
Spring 6A	09/21	1	UF												<0.1
Spring 7	09/21	1	F	<11	<72	<2	25	23	<1	<3	<6	<5	<10	<63	
Spring 7	09/21	2	F	<11	<72	<2	15	24	<1	<3	<6	<5	<10	<63	
Spring 7	09/21	1	UF												<0.1
Spring 7	09/21	2	UF												<0.1
Spring 8B	09/22	1	F	<11	<72	<2	10	24	<1	<3	<12	<5	<10	<63	
Spring 8B	09/22	1	UF												<0.1
Spring 9	09/22	1	F	<11	<72	<2	<18	14	<1	<3	<6	<5	<10	<63	
Spring 9	09/22	1	UF												<0.1
White Rock Canyon Group III:															
Spring 1	09/20	1	F	<11	<72	3	30	24	<1	<3	<6	6	<10	<63	
Spring 1	09/20	1	UF												<0.1
Spring 2	09/20	1	UF												<0.1
White Rock Canyon Group IV:															
La Mesita Spring	07/19	1	F	<6	<1,400	<2	55	103	<1	<3	<6	<5	<4	<570	
La Mesita Spring	07/19	1	UF												<0.1
Other Springs:															
Sacred Spring	07/22	1	F	<6	<200	2	37	76	<1	<3	<20	<5	<4	<20	
Sacred Spring	07/22	1	UF												<0.1
Canyon Alluvial Groundwater Systems															
Acid/Pueblo Canyons:															
APCO-1	03/25	1	F	<6	62	5	302	41	1	<3	<6	<5	11	41	
APCO-1	03/25	1	UF	<6	109	5	321	43	1	<3	<6	<5	6	68	<0.3
Cañada del Buey:															
CDBO-6	06/30	1	F	<6	<1,400	2	39	77	<1	<3	<6	<5	<4	<570	
CDBO-6	06/30	1	UF												<0.1
CDBO-6	06/30	D	UF	<6	4,334	2	35	98	<1	<3	<6	<5	<4	2,427	
CDBO-7	10/06	1	F	<6	110	<2	43	88	1	<3	<6	<5	<8	<30	
CDBO-7	10/06	1	UF	<6	226	<3	52	90	1	<3	<6	<5	9	106	
CDBO-7	10/06	D	UF												<0.1
DP/Los Alamos Canyons:															
LAO-C	04/08	1	F	<6	1,083	<2	<13	62	1	<3	6	<5	<4	554	
LAO-C	04/08	1	UF	<6	1,398	2	<9	62	1	<3	6	<5	<4	704	<0.1

Table 5-21. Trace Metals in Groundwater for 1999 (µg/L) (Cont.)

Station Name	Date	Code[a]	F/UF[b]	Ag	Al	As	B	Ba	Be	Cd	Co	Cr	Cu	Fe	Hg
Canyon Alluvial Groundwater Systems (Cont.)															
DP/Los Alamos Canyons: (Cont.)															
LAO-0.7	04/08	1	F	<6	329	<2	<12	42	1	<3	<6	<5	<4	78	
LAO-0.7	04/08	1	UF	13	982	<2	<9	52	1	<3	<6	<5	<4	430	<0.1
LAO-1	04/08	1	F	<6	634	<2	<9	36	1	<3	<6	14	<4	245	
LAO-1	04/08	1	UF	<6	755	<2	<9	37	1	<3	<6	13	<4	283	<0.1
LAO-2	04/07	1	F	<6	325	<2	11	50	1	<3	<6	<5	<4	89	
LAO-2	04/07	1	UF	<6	550	<2	10	52	1	<3	<6	<5	<4	173	<0.1
LAO-3A	04/07	1	F	<6	117	<2	17	69	1	<3	<6	<5	<4	<30	
LAO-3A	04/07	2	F	<6	147	<2	19	70	1	<3	<6	<5	<4	<30	
LAO-3A	04/07	1	UF	<6	197	2	18	68	1	<3	<6	<5	<4	<30	<0.1
LAO-3A	04/07	2	UF	<6	166	2	21	69	1	<3	<6	<5	<4	<30	<0.1
LAO-4	11/29	1	F	<6	550	<2	31	31	<1	<3	<6	<5	<4	239	
LAO-4	11/29	1	UF	<6	586	<2	36	34	<1	<3	<6	<5	<4	240	<0.1
LAO-4.5C	03/25	1	F	<6	938	<2	31	34	1	<3	<6	<5	<4	381	
LAO-4.5C	03/25	1	UF	<6	905	<2	23	34	1	<3	<6	<5	<10	379	<0.3
LAO-5	03/25	1	F	<6	586	<2	34	23	1	<3	<6	<5	<4	190	
LAO-5	03/25	1	UF	<6	766	<2	26	31	2	<3	<6	<5	<4	292	<0.28
Mortandad Canyon:															
MCO-3	04/16	1	F	<6	145	<2	67	29	1	<3	<6	<5	23	83	
MCO-3	04/16	1	UF	<6	201	<2	63	28	<1	<3	<6	<5	7	123	<0.1
MCO-5	04/14	1	UF	<6	<40	<2	93	160	<1	<3	<6	<5	<4	36	<0.1
MCO-5	04/15	1	F	<6	<40	<2	81	153	<1	<3	<6	<5	<11	<30	
MCO-6B	04/14	1	F	<6	<82	<2	82	134	<1	<10	<6	<5	<4	70	
MCO-6B	04/14	1	UF	<6	117	<2	82	133	<1	<3	<6	<5	<4	41	<0.1
MCO-7	04/13	1	F	29	321	<2	72	157	<1	<3	<6	<5	<4	140	
MCO-7	04/13	1	UF	<6	950	<2	81	162	<1	<3	<6	<5	<4	506	<0.1
MCO-7.5	03/26	1	F	<6	106	<2	69	153	1	<3	<6	5	<4	<30	
MCO-7.5	03/26	1	UF	<6	190	<2	67	155	1	<3	<6	<5	<4	76	<0.3
MT-3	11/09	1	F	<6	200	<2	33	86	1	<3	<6	<5	5	183	
MT-3	11/09	1	UF	<6	7,602	<4	35	1,111	5	<3	12	<5	13	3,836	<0.1
Pajarito Canyon:															
PCO-1	03/26	1	F	<6	2,110	<2	26	70	1	<3	<6	<5	<4	1,050	
PCO-1	03/26	1	UF	<6	1,710	<2	25	71	1	<3	<6	<5	<4	961	<0.3

Table 5-21. Trace Metals in Groundwater for 1999 (μg/L) (Cont.)

Station Name	Date	Code[a]	F/UF[b]	Ag	Al	As	B	Ba	Be	Cd	Co	Cr	Cu	Fe	Hg
Intermediate Perched Groundwater Systems															
Pueblo/Los Alamos Canyon Area:															
Test Well 2A	05/27	1	UF												<0.1
Test Well 2A	05/27	D	UF	<6	81	<2	80	50	<1	<3	<6	<5	<4	1,892	
Basalt Spring	07/19	1	F	<6	<1,400	7	225	71	<1	<3	<6	<5	<4	<570	
Basalt Spring	07/19	1	UF												<0.1
Perched Groundwater System in Volcanics:															
Water Canyon Gallery	08/03	1	UF	<6	172	<2	<15	13	1	<3	<6	<5	<4	58	<0.1
San Ildefonso Pueblo:															
LA-5	07/22	1	UF	<6	<190	2	31	74	<1	<3	<6	7	<4	43	<0.1
Eastside Artesian Well	07/21	1	UF	<6	<200	<2	122	4	<1	<3	<20	<5	<4	126	<0.1
Pajarito Well (Pump 1)	07/20	1	UF	<6	<1,400	8	1,313	78	<1	<3	<6	<5	<4	<570	0.1
Don Juan Playhouse Well	07/21	1	UF	<6	<200	4	85	33	<1	<3	<20	8	<4	<20	<0.1
New Community Well	07/20	1	UF	<6	<200	2	49	16	<1	<3	<20	<5	<4	<20	<0.1
Sanchez House Well	07/22	1	UF	<6	<190	11	250	92	<1	<3	8	<5	7	<30	<0.1
Water Quality Standards[d]															
EPA Primary Drinking Water Standard						50		2,000	4	5		100			2.0
EPA Secondary Drinking Water Standard					50–200									300	
EPA Action Level													1,300		
EPA Health Advisory															
NMWQCC Livestock Watering Standard					5,000	200	5,000			50	1,000	1,000	500		10.0
NMWQCC Groundwater Limit				50	5,000	100	750	1,000		10	50	50	1,000	1,000	2.0

Table 5-21. Trace Metals in Groundwater for 1999 (μg/L) (Cont.)

Station Name	Date	Code[a]	F/UF[b]	Mn	Mo	Ni	Pb	Sb	Se	Sn	Sr	Ti	V	Zn
Regional Aquifer Wells														
Test Wells:														
Test Well 1	05/27	1	UF						<3					
Test Well 1	05/27	D	UF	26	<10	<20	77	6		<60	270	<3	<7	655
Test Well 2	08/11	1	UF						<3					
Test Well 2	08/11	D	UF	28	<22	<20	<60	<4		<60	33	<3	<7	321
Test Well 3	05/27	1	UF						<3					
Test Well 3	05/27	D	UF	14	<10	<20	<60	<4		<60	71	<3	10	51
Test Well 4	05/27	1	UF						<3					
Test Well 4	05/27	D	UF	25	<10	<20	<60	<4		<60	43	<3	<7	1,518
Test Well 8	08/03	1	UF	2	<10	<20	<60	<4	<3	<60	51	<3	<7	559
Test Well 8	08/03	2	UF	2	<10	<20	<60	<4	<3	<60	52	<3	<7	577
Test Well DT-5A	08/11	1	UF						<3					
Test Well DT-5A	08/11	D	UF	8	<10	<20	<60	<4		<60	46	<3	7	254
Test Well DT-9	06/02	1	UF						<3					
Test Well DT-9	06/02	D	UF	1	<10	<20	<60	<4		<60	46	<3	<7	94
Test Well DT-10	06/03	1	UF						<3					
Test Well DT-10	06/03	D	UF	<1	<10	<20	<60	<4		<60	46	<3	<7	59
Water Supply Wells:														
O-4	12/13	1	UF											
PM-1	12/13	1	UF											
G-2A (GR-2)	11/30	1	UF	<1	<10	<20	<60	<4	<3	<60	52	<3	52	<10
G-3A (GR-3)	11/30	1	UF	1	<10	<20	<60	<4	<3	<60	50	<3	51	<10
G-5A (GR-1)	11/30	1		<1	<10	<20	<60	<4	<3	<60	51	<3	52	<10
Regional Aquifer Springs														
White Rock Canyon Group I:														
Sandia Spring	09/20	1	F	78	<10	<20	<60	<4		<60	323	<3	<7	<10
Sandia Spring	09/20	1	UF						<3					
Spring 3	09/20	1	F	2	<10	<20	<60	<4		<60	217	<3	14	<10
Spring 3	09/20	1	UF						<3					
Spring 3AA	09/20	1	F	<1	<10	<20	<60	<4		<60	148	<3	13	<10
Spring 3AA	09/20	1	UF						<3					
Spring 4A	09/21	1	F	<1	<10	<61	<60	<4		<85	90	<3	8	<10
Spring 4A	09/21	1	UF						<3					
Spring 5	09/21	1	F	1	<10	<20	<60	<4		<60	82	<3	<13	10
Spring 5	09/21	1	UF						<3					
Ancho Spring	09/21	1	F	11	<10	<20	<60	<4		<60	58	<3	<7	<10
Ancho Spring	09/21	1	UF						<3					

Table 5-21. Trace Metals in Groundwater for 1999 (μg/L) (Cont.)

Station Name	Date	Code[a]	F/UF[b]	Mn	Mo	Ni	Pb	Sb	Se	Sn	Sr	Ti	V	Zn
Regional Aquifer Springs (Cont.)														
White Rock Canyon Group II:														
Spring 6A	09/21	1	F	4	<10	<20	<60	<4		<83	128	<3	12	12
Spring 6A	09/21	1	UF						<3					
Spring 7	09/21	1	F	2	<10	<20	<60	<4		<60	59	<3	<7	<10
Spring 7	09/21	2	F	2	<10	<69	<60	<4		<60	64	<3	<7	<10
Spring 7	09/21	1	UF						<3					
Spring 7	09/21	2	UF						<3					
Spring 8B	09/22	1	F	24	<10	<20	<60	<4		<60	52	<3	<7	<10
Spring 8B	09/22	1	UF						<3					
Spring 9	09/22	1	F	1	<10	<20	<60	<4		<60	50	<3	<7	<10
Spring 9	09/22	1	UF						6					
White Rock Canyon Group III:														
Spring 1	09/20	1	F	1	<10	<20	<60	<4		<60	183	<3	13	<10
Spring 1	09/20	1	UF						3					
Spring 2	09/20	1	UF						<3					
White Rock Canyon Group IV:														
La Mesita Spring	07/19	1	F	2	<10	<20	<60	<4		<60	799	<3	<7	<10
La Mesita Spring	07/19	1	UF						<3					
Other Springs:														
Sacred Spring	07/22	1	F	4	<10	<20	<60	<4		<60	435	<3	<20	<40
Sacred Spring	07/22	1	UF						<3					
Canyon Alluvial Groundwater Systems														
Acid/Pueblo Canyons:														
APCO-1	03/25	1	F	234	<10	<20	<60	<4		<60	97	<3	<7	26
APCO-1	03/25	1	UF	207	10	<20	<60	<4	<3	<60	98	<3	8	26
Cañada del Buey:														
CDBO-6	06/30	1	F	<1	<10	<63	<60	<4		<60	97	<3	<7	<10
CDBO-6	06/30	1	UF						<3					
CDBO-6	06/30	D	UF	14	<10	<20	<60	<4		<60	94	<3	<7	<10
CDBO-7	10/06	1	F	1	<10	<20	<60	<4		<60	126	<3	<7	<10
CDBO-7	10/06	1	UF	2	<18	<20	<60	<4	<4	<60	128	<3	7	<10
CDBO-7	10/06	D	UF						<3					
DP/Los Alamos Canyons:														
LAO-C	04/08	1	F	5	<10	<20	<60	<4		<60	118	<3	<7	<10
LAO-C	04/08	1	UF	5	<10	202	<60	<4	<3	<60	117	<3	<7	<10

Table 5-21. Trace Metals in Groundwater for 1999 (μg/L) (Cont.)

Station Name	Date	Code[a]	F/UF[b]	Mn	Mo	Ni	Pb	Sb	Se	Sn	Sr	Ti	V	Zn
Canyon Alluvial Groundwater Systems														
DP/Los Alamos Canyons: (Cont.)														
LAO-0.7	04/08	1	F	93	<10	<20	<60	<4		<60	125	<3	<7	<10
LAO-0.7	04/08	1	UF	292	<10	<20	<60	<4	<3	<60	121	<3	<7	<10
LAO-1	04/08	1	F	3	14	<20	<60	<4		<60	108	<3	<7	<10
LAO-1	04/08	1	UF	3	<10	<20	<60	<4	<3	<60	107	<3	<7	<10
LAO-2	04/07	1	F	1	257	<20	<60	<4		<60	134	<3	<7	<10
LAO-2	04/07	1	UF	2	239	<20	<60	<4	<3	<60	131	<3	<7	<10
LAO-3A	04/07	1	F	<1	679	<20	<60	<4		<60	180	<3	<7	<10
LAO-3A	04/07	2	F	1	690	<20	<60	<4		<60	183	<3	<7	<10
LAO-3A	04/07	1	UF	1	665	<20	<60	<4	<3	<60	177	<3	<7	<10
LAO-3A	04/07	2	UF	1	657	<20	<60	<4	<3	<60	176	<3	<7	<10
LAO-4	11/29	1	F	10	<10	<20	<60	<4		<60	74	<3	<7	<10
LAO-4	11/29	1	UF	1	<10	<20	<60	<4	<3	<60	76	<3	<7	<10
LAO-4.5C	03/25	1	F	5	24	<20	<60	<4		<60	75	<3	<7	10
LAO-4.5C	03/25	1	UF	2	17	<20	<60	<4	<3	<60	73	<3	<7	17
LAO-5	03/25	1	F	<1	13	<20	<60	<4		<60	74	<3	<7	<10
LAO-5	03/25	1	UF	1	<10	<20	<60	<4	<3	<60	76	<3	<7	<10
Mortandad Canyon:														
MCO-3	04/16	1	F	1	123	<20	<60	<4		<60	64	<3	<7	<10
MCO-3	04/16	1	UF	6	117	<20	<60	<4	<3	<60	63	<3	<7	<10
MCO-5	04/14	1	UF	6	71	<20	<60	<4	<3	<60	226	<3	<7	<10
MCO-5	04/15	1	F	5	63	<20	<60	<4		<60	216	<3	<7	<10
MCO-6B	04/14	1	F	6	71	<20	<60	<4		<60	198	<3	<7	16
MCO-6B	04/14	1	UF	6	63	<20	<60	<4	<3	<60	200	<3	<7	<10
MCO-7	04/13	1	F	6	98	<20	<60	<4		<60	119	<3	<7	<10
MCO-7	04/13	1	UF	16	116	<20	<60	<4	<3	<60	121	<3	<7	10
MCO-7.5	03/26	1	F	<1	99	<20	<60	<4		<60	127	<3	<7	<10
MCO-7.5	03/26	1	UF	1	101	<20	<60	<4	<3	<60	130	<3	<7	<10
MT-3	11/09	1	F	9	<35	<20	<60	<4		<60	116	<3	<7	<10
MT-3	11/09	1	UF	901	<10	<59	<60	<4	<3	<60	199	<3	17	77
Pajarito Canyon:														
PCO-1	03/26	1	F	35	<10	<20	<60	<4		<60	95	<3	<7	<10
PCO-1	03/26	1	UF	39	<10	<20	<60	<4	<3	<60	94	<3	<7	<10

Table 5-21. Trace Metals in Groundwater for 1999 (µg/L) (Cont.)

Station Name	Date	Code[a]	F/UF[b]	Mn	Mo	Ni	Pb	Sb	Se	Sn	Sr	Ti	V	Zn
Intermediate Perched Groundwater Systems														
Pueblo/Los Alamos Canyon Area:														
Test Well 2A	05/27	1	UF						<3					
Test Well 2A	05/27	D	UF	127	<10	<20	91	<4		<60	219	<3	<7	4,981
Basalt Spring	07/19	1	F	<1	<10	<20	<60	<4		<60	109	<3	<7	<10
Basalt Spring	07/19	1	UF						<3					
Perched Groundwater System in Volcanics:														
Water Canyon Gallery	08/03	1	UF	1	<10	<33	<60	<4	<3	<60	50	<3	<7	<10
San Ildefonso Pueblo:														
LA-5	07/22	1	UF	3	<10	<20	<60	<4	<3	<60	240	<3	15	57
Eastside Artesian Well	07/21	1	UF	9	<10	<20	<60	<4	<3	<60	53	<3	<20	<40
Pajarito Well (Pump 1)	07/20	1	UF	<1	<10	<20	<60	<4	<3	<84	1,118	<3	13	<10
Don Juan Playhouse Well	07/21	1	UF	6	<10	<20	<60	<4	<3	<60	168	<3	<20	<40
New Community Well	07/20	1	UF	<1	<10	<20	<60	<4	<3	<60	208	<3	<20	<40
Sanchez House Well	07/22	1	UF	<1	10	<20	<60	<4	<3	<60	317	<3	16	<10
Water Quality Standards[d]														
EPA Primary Drinking Water Standard						100		6	50			2		
EPA Secondary Drinking Water Standard				50										5,000
EPA Action Level							15							
EPA Health Advisory											25,000–90,000		80–110	
NMWQCC Livestock Watering Standard							100		50				100	25,000
NMWQCC Groundwater Limit				200	1,000	200	50		50					10,00

[a] Codes: 1–primary analysis; 2–secondary analysis; R–lab replicate; D–lab duplicate.
[b] F/UF: F-filtered; UF-unfiltered.
[c] Less than symbol (<) means measurement was below the specified limit of detection of the analytical method.
[d] Standards given here for comparison only; see Appendix A. Note that New Mexico Livestock Watering and Groundwater limits are based on dissolved concentrations, whereas many of these analyses are of unfiltered samples; thus, concentrations may include suspended sediment quantities.

Table 5-22. Number of Samples Collected for Each Suite of Organic Compounds in Groundwater for 1999

		Organic Suite[a]			
Station Name	**Date**	**HE**	**PCB**	**Semivolatile**	**Volatile**
Ancho Spring	09/21	1	1	1	1
APCO-1	03/25				1
Basalt Spring	07/19		1	1	1
CDBO-6	06/30		1	1	1
Don Juan Playhouse Well	07/21		1	1	1
Eastside Artesian Well	07/21		1	1	1
G-1	03/09	1			
G-2	03/09	1			
G-6	03/09	1			
G-1A	03/09	1			
G-2A	11/30	1			
G-3A	11/30	1			
G-4A	06/09	1			
G-5A	11/30	1			
La Mesita Spring	07/19	1	1	1	1
LAO-4.5C	03/25		1	1	1
New Community Well	07/20		1	1	1
O-1	06/09	1			
O-4	03/09	1			
O-4	06/08	1			
Pajarito Well (Pump 1)	07/20		1	1	1
PCO-1	03/26	1			
PM-1	03/09	1			
PM-1	06/08	1			
PM-2	03/09	2			
PM-2	06/08	1			
PM-2	09/28	1			
PM-2	11/04	1			
PM-2	12/13	1			
PM-3	03/09	1			
PM-3	06/08	1			
PM-4	03/26	2	1	1	
PM-4	03/29	2			
PM-4	03/30	1			
PM-4	06/09	2			
PM-5	03/09	1			
PM-5	06/09	1			
PM-5	09/28	1			
PM-5	11/04	1			
PM-5	12/13	1			
Sandia Spring	09/20	1	1	1	
Spring 1	09/20	1	1	1	1
Spring 2	09/20	1			
Spring 3	09/20	1	1	1	1
Spring 3AA	09/20	1	1	1	1
Spring 4A	09/21	1	1	1	1

Table 5-22. Number of Samples Collected for Each Suite of Organic Compounds in Groundwater for 1999 (Cont.)

		Organic Suite[a]			
Station Name	**Date**	**HE**	**PCB**	**Semivolatile**	**Volatile**
Spring 5	09/21	1	1	1	1
Spring 6A	09/21	1			
Spring 7	09/21	2	2	2	2
Spring 8B	09/22	1			
Spring 9	09/22	1			
Test Well 1	06/03	1			
Test Well 2	08/11	1			
Test Well 2A	06/03	1			
Test Well 3	06/03	1			
Test Well 4	06/02	1			
Test Well 8	08/03	2			2
Test Well DT-10	06/03	1			
Test Well DT-5A	08/11	2			
Test Well DT-9	06/02	1			

[a] High explosives, polychlorinated biphenyls, semivolatiles, and volatiles.

Table 5-23. Special Los Alamos Water Supply Sampling during 1999

Location	Date	Analytes	Date	Analytes	Date	Analytes	Date	Analytes	Date	Analytes
G-1	03/09	HE								
G-2	03/09	HE								
G-6	03/09	HE								
G-1A	03/09	HE								
G-2A							11/30	HE		
G-3A							11/30	HE		
G-4A				06/09	HE					
G-5A							11/30	HE		
PM-1	03/09	HE	06/09	HE					12/13	As, U, ^{90}Sr
PM-2	03/09	HE	06/09	HE	09/28	HE	11/04	HE	12/13	HE, ClO_4
PM-3	03/09	HE	06/09	HE						
PM-4	03/25	HE	06/09	HE						
PM-5	03/09	HE	06/09	HE	09/28	HE	11/04	HE	12/13	HE, ClO_4
O-1			06/09	HE						
O-4	03/09	HE	06/09	HE					12/13	As, U, ^{90}Sr

Table 5-24. Quality Assurance Sample Results for Strontium-90 Analysis of Water Samples in 1999[a,b] (pCi/L)

Station Name	Date	Code	^{90}Sr	Uncertainty	Detection Limit	Detect?
DI Blank	03/09	1	0.24	0.16	0.49	ND[c]
DI Blank	04/08	1	2.52	0.25	0.28	Detect
DI Blank	06/09	1	–0.25	0.06	0.11	ND
DI Blank	06/09	1	0.54	0.15	0.29	Detect
DI Blank	07/21	1	0.59	0.17	0.33	Detect
DI Blank	09/20	1	–0.15	0.14	0.29	ND
Average Analytical Detection Limit			0.30			
Average of Blank Values			0.58	0.16		
Standard Deviation of Blank Values			1.01			
Std. Dev. of Blank/Detection Limit (Should be <0.33)			3.39			
Spiked Sample	03/29	1	4.45	0.37	0.34	Detect
Spiked Sample	04/13	1	4.22	0.34	0.27	Detect
Spiked Sample	06/30	1	0.81	0.17	0.29	Detect
Spiked Sample	08/11	1	5.61	0.43	0.34	Detect
Spiked Sample	09/22	1	4.62	0.37	0.31	Detect
Spiked Sample	12/01	1	2.24	0.33	0.48	Detect
Average Analytical Detection Limit			0.34			
Average of Spiked Value			3.66	0.34		
Standard Deviation of Spiked Values			1.78			
Spiked Concentration			5.00	0.50		
Ratio of Result/Spiked Value			0.73			
Calculated Detection Limit (Std. Dev. of spikes × 3)			5.33			
Calculated Detection Limit/Analytical Detection Limit (Should be ≤1)			15.76			

[a] Two columns are listed: the first is the value; the second is the radioactive counting uncertainty (1 std dev). Radioactivity counting uncertainties may be less than analytical method uncertainties.
[b] See Appendix B for an explanation of negative numbers.
[c] ND = not detected.

Table 5–25. Quality Assurance Sample Results for Radiochemical Analysis of Water Samples in 1999[a,b] (pCi/L[c])

Station Name	Date	Code	^{3}H		^{137}Cs		U (μg/L)		^{238}Pu		^{239,240}Pu		^{241}Am		Gross Alpha		Gross Beta		Gross Gamma	
DI Blank	03/09	1	–110	610	0.14	1.11	0.11	0.01	–0.006	0.007	0.023	0.011	0.034	0.014	0.85	0.71	0.71	12.30	100.70	51.07
DI Blank	04/08	1	–10	610	–1.13	7.41	0.00	0.05	0.004	0.007	0.010	0.010	0.031	0.009	0.11	0.87	0.56	1.16	23.50	50.80
DI Blank	06/09	1	240	610	0.00	7.43	0.07	0.05	0.010	0.008	0.016	0.009	0.049	0.013	0.27	1.39	–0.17	0.11	107.00	50.60
DI Blank	07/21	1	500	640	0.69	0.83	–0.08	0.10	0.027	0.010	0.035	0.012	0.010	0.005	0.04	0.09	0.08	0.12	46.20	50.10
DI Blank	09/20	1	–30	610	0.00	7.42	0.00	0.05	0.015	0.009	0.005	0.006	–0.025	0.038	0.04	0.05	0.43	1.78	91.10	48.70
DI Blank	12/09	1			0.00	0.33			0.008	0.006	0.004	0.006							47.20	48.50
Analytical Detection Limit			700		4.00		0.10		0.040		0.040		0.040		3.00		3.00		120.00	
Average of Blank Values			118		–0.05	4.09	0.02	0.05	0.010	0.008	0.016	0.009	0.020	0.016	0.26	0.62	0.32	3.09	69.28	49.96
Standard Deviation of Blank Values			251		0.59		0.07		0.011		0.012		0.029		0.34		0.36		34.65	
Std. Dev. Of Blank/Detection Limit (Should be <0.33)			0.36		0.15		0.73		0.272		0.294		0.714		0.11		0.12		0.29	
Spiked Sample	03/29	1	260	610	0.59	1.12	0.16	0.05	0.087	0.021	0.133	0.025	0.132	0.020	0.53	1.37	13.70	4.41	65.80	51.10
Spiked Sample	04/13	1			1.12	0.93			0.087	0.026	0.106	0.027	0.143	0.031	0.27	0.48	9.10	2.73	176.90	51.30
Spiked Sample	04/16	1	0	620			1.63	0.05												
Spiked Sample	06/30	1	310	660	0.46	1.17	0.00	0.01	0.093	0.018	0.096	0.018	0.170	0.023	0.34	0.51	22.70	6.28	209.00	51.40
Spiked Sample	06/30	1D					–0.09	5.00												
Spiked Sample	08/11	1	–130	590	–0.81	5.45	0.00	0.01	0.108	0.022	0.128	0.022	0.108	0.024	0.55	0.91	9.44	3.54	15.40	50.40
Spiked Sample	08/11	1D					–0.06	0.05												
Spiked Sample	09/22	1	10	610	0.00	5.43	–0.01	0.05	0.121	0.025	0.122	0.024	0.110	0.048	0.63	1.41	9.46	3.66	37.60	48.30
Spiked Sample	12/01	1			2.84	1.82	0.20	0.20	0.118	0.022	0.125	0.023	0.119	0.020	0.56	2.62	8.51	3.60	67.50	48.90
Average of Spiked Value			90	618	0.70	2.65	0.23	0.68	0.103	0.022	0.118	0.023	0.130	0.028	0.48	1.22	12.15	4.04	95.37	50.23
Standard Deviation of Spiked Values			187		1.23		0.58		0.015		0.014		0.023		0.14		5.49		78.67	
Spiked Concentration			0		0.00		0.00		0.100	0.010	0.100	0.010	0.100	0.010						
Ratio of Result/Spiked Value									1.026		1.183		1.302							
Calclulated Detection Limit (Standard Deviation of Spikes × 3)					3.70				0.046		0.043		0.070							
Calculated Det. Limit/Analytical Det. Limit (Should be ≤1.00)					0.92				1.160		1.069		1.754							

[a] Two columns are listed: the first is the value; the second is the radioactive counting uncertainty (1 std dev). Radioactivity counting uncertainties may be less than analytical method uncertainties.
[b] See Appendix B for an explanation of negative numbers.
[c] Except where noted.

Table 5-26. Quality Assurance Sample Results for Metals Analysis of Water Samples in 1999 (μg/L)

Station Name	Date	Ag	Al	As	B	Ba	Be	Cd	Co	Cr	Cu	Fe	Hg
DI Blank	04/08	<6	210	<2	<9	<2	1	<3	<6	<5	<4	<30	<0.10
DI Blank	07/21	<6	<200	<2	11	<2	<1	<3	<20	<5	<4	<20	<0.10
DI Blank	09/20	<11	<72	<4	29	<2	<1	<3	8	<5	22	<63	
DI Blank	09/22												<0.10
Spiked Sample	03/29	24	104	<2	<9	512	1	<3	<6	<5	<4	<30	4.20
Spiked Sample	04/16	19	<40	<2	<19	464	<1	<3	<6	<5	<4	31	4.06
Spiked Sample	06/30	14	<1,400	<2	<17	481	<1	<3	<6	<5	<4	<30	3.82
Spiked Sample	08/11	30	<40	<3	<16 0	360	<1	<3	<10	<5	<20	280	4.04
Spiked Sample	09/22	14	<72	<2	<9	469	<1	<3	<6	<5	<10	<63	3.28
Spiked Sample	12/01	8	<70	<2	<9	492	<1	<3	<6	<5	<4	<30	4.18
Average of Results		18				463							3.93
Standard Deviation of Results		8				53							0.35
Spiked Concentration		25				500							5.00
Ratio of Result/Spiked Value		0.73				0.93							0.79

Table 5-26. Quality Assurance Sample Results for Metals Analysis of Water Samples in 1999 (µg/L) (Cont.)

Station Name	Date	Mn	Mo	Ni	Pb	Sb	Se	Sn	Sr	Tl	V	Zn
DI Blank	04/08	1	<10	<20	<60	<4	<3	<60	<1	<3	<7	<10
DI Blank	07/21	<1	<10	<20	<60	<4	<3	<60	<1	<3	<20	<40
DI Blank	09/20	<1	<10	<20	<60	<4		<60	2	<3	<7	36
DI Blank	09/22						<3					
Spiked Sample	03/29	<1	<10	<20	<60	<4	<3	<60	<1	<3	<7	<10
Spiked Sample	04/16	6	<10	<20	<60	<4	<3	<60	<1	<3	<7	<10
Spiked Sample	06/30	<1	<10	<20	<60	<4	<3	<60	<1	<3	<7	<10
Spiked Sample	08/11	8	<10	<20	<60	<4	<3	<60	10	<3	<7	77
Spiked Sample	09/22	<1	<10	<45	<60	<4	<3	<60	<1	<3	<7	<10
Spiked Sample	12/01	<1	<10	<20	<60	<4	<3	<60	<1	<3	<7	10
Average of Results												
Standard Deviation of Results												
Spiked Concentration												
Ratio of Result/Spiked Value												

J. Figures

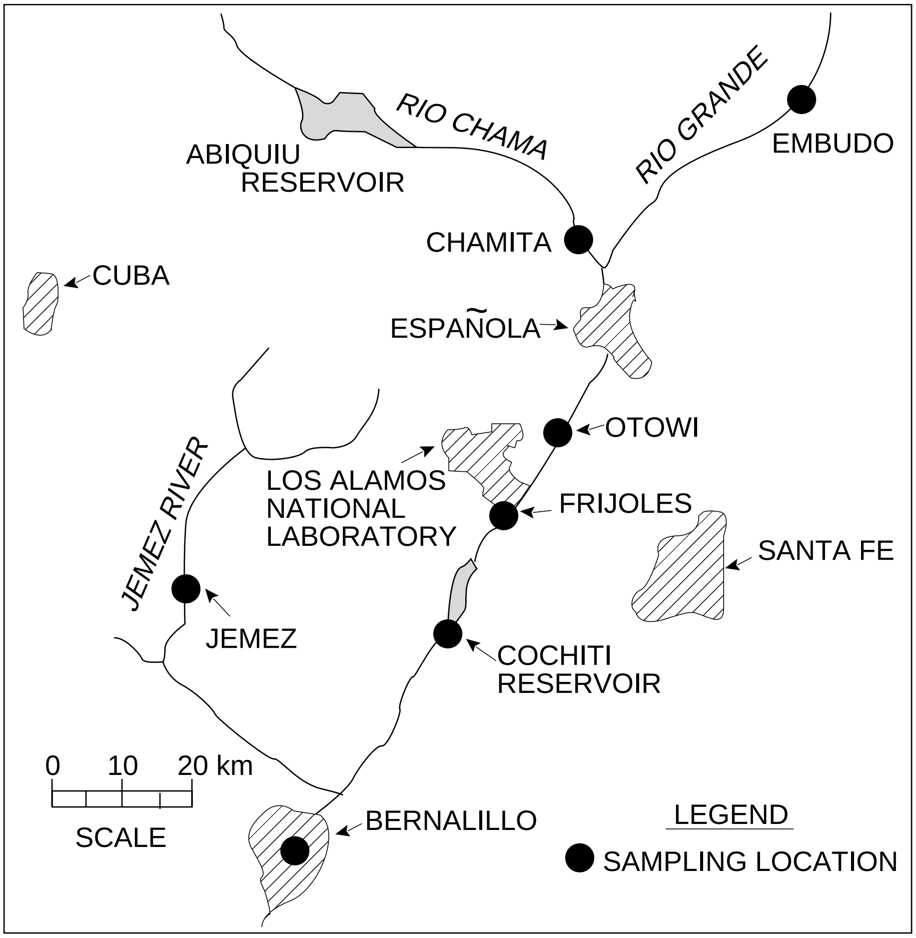


Figure 5-1. Regional surface water and sediment sampling locations.

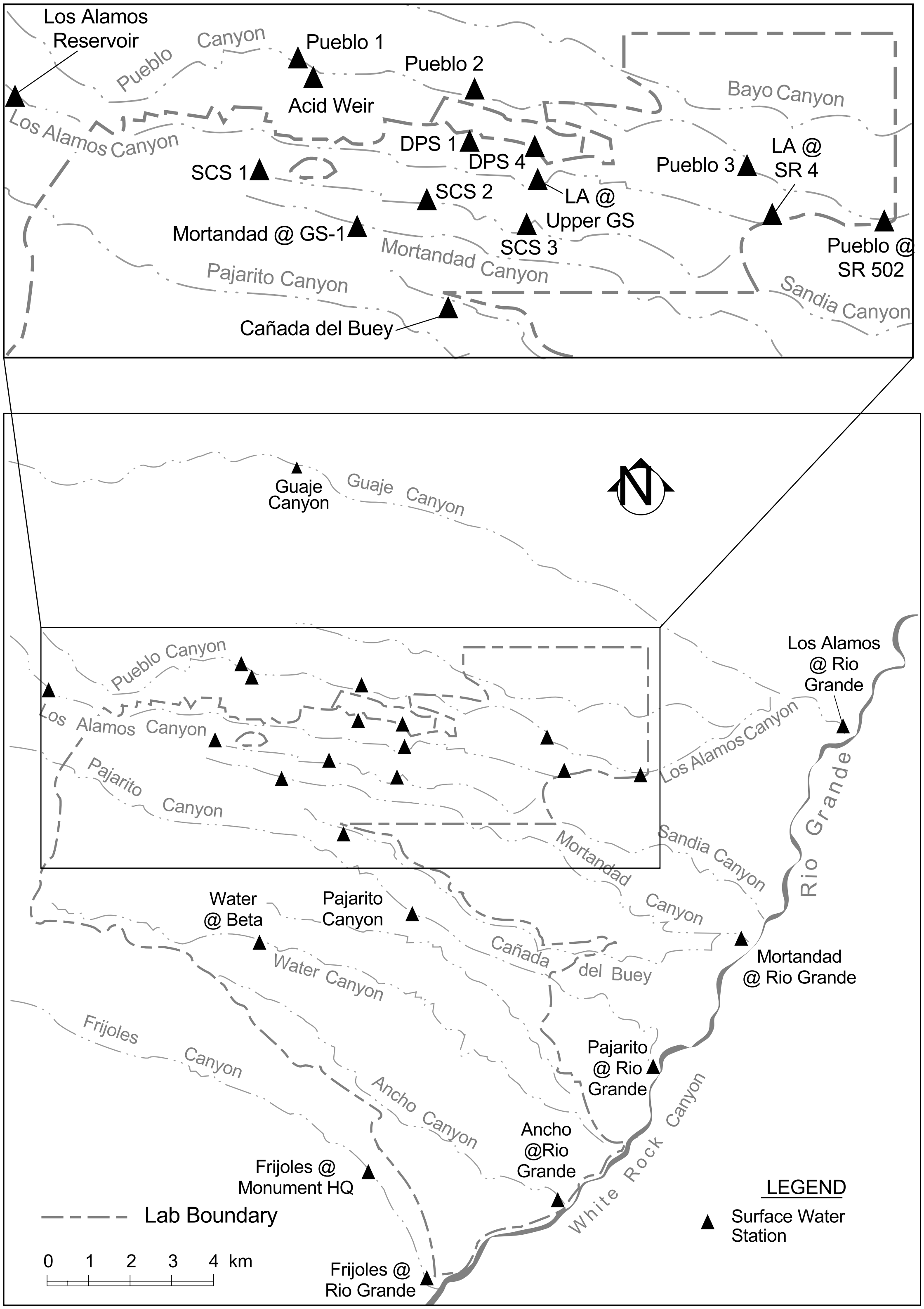


Figure 5-2. Surface water sampling locations in the vicinity of Los Alamos National Laboratory.

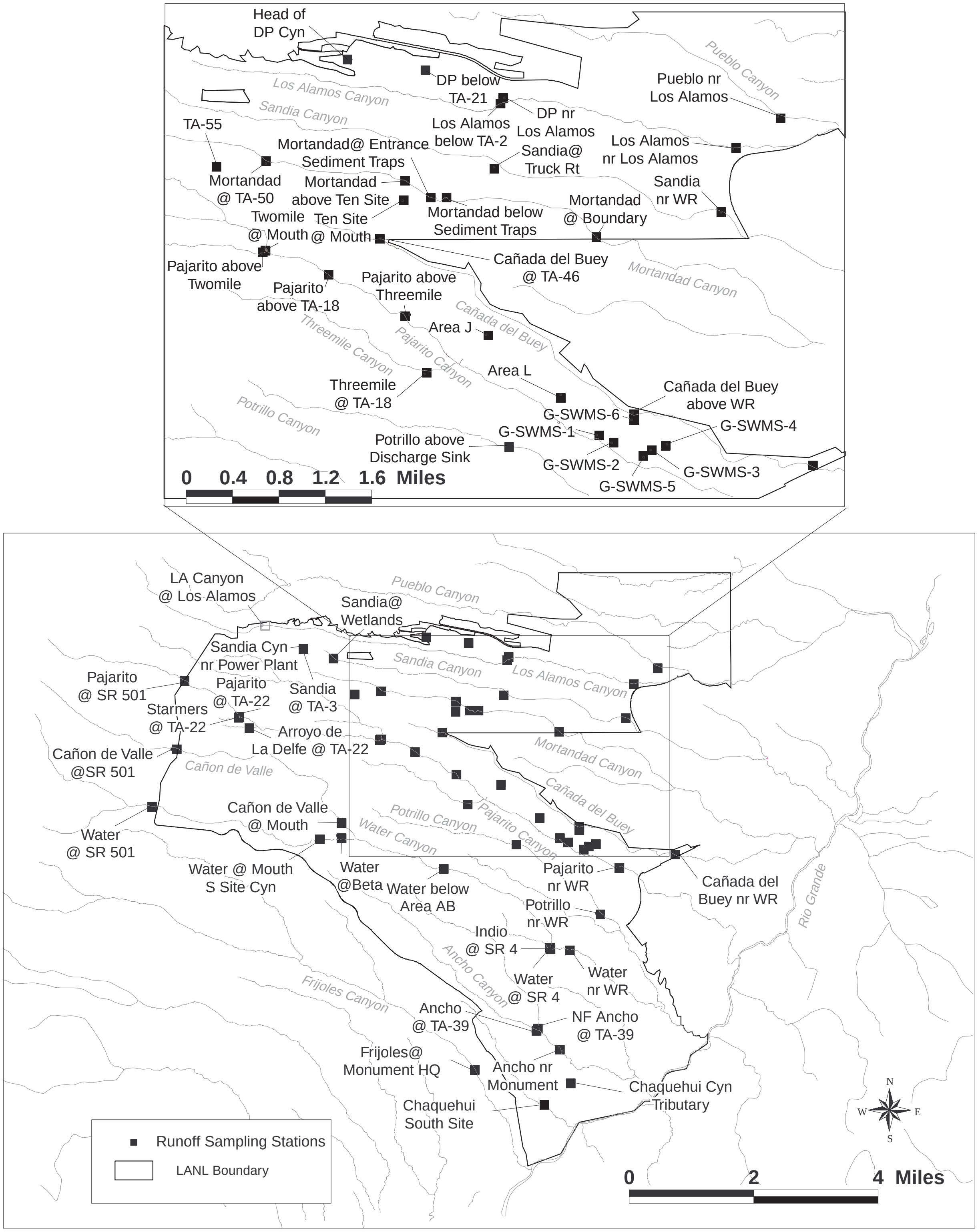


Figure 5-3. Runoff sampling stations in the vicinity of Los Alamos National Laboratory.

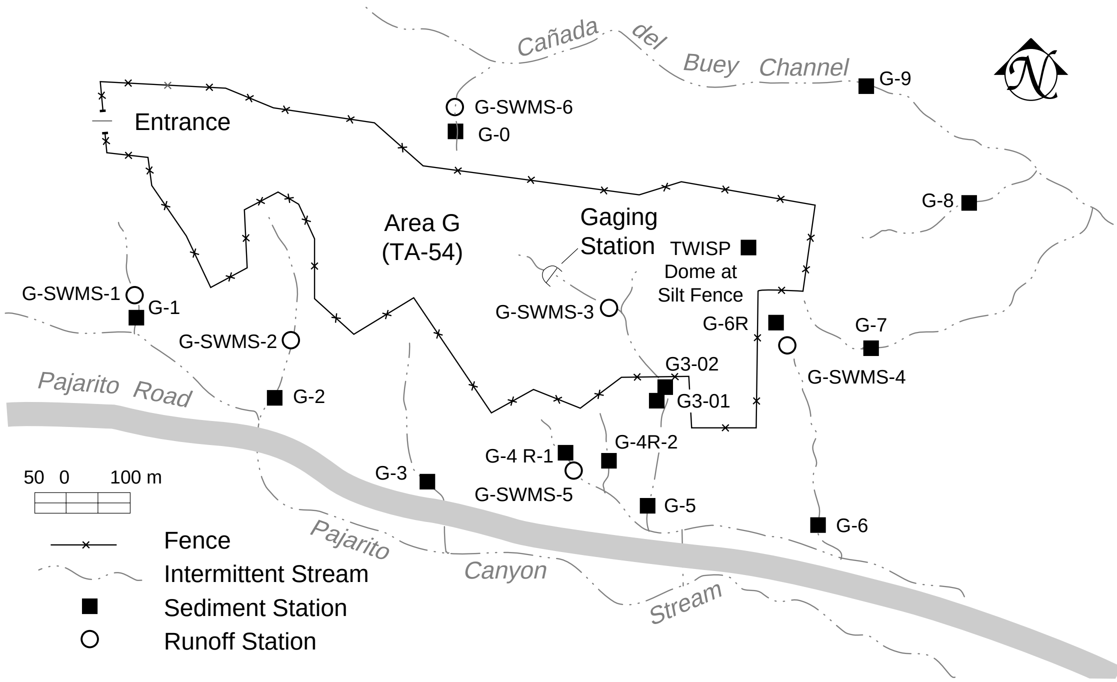


Figure 5-4. Sediment and runoff sampling stations at TA-54, Area G.

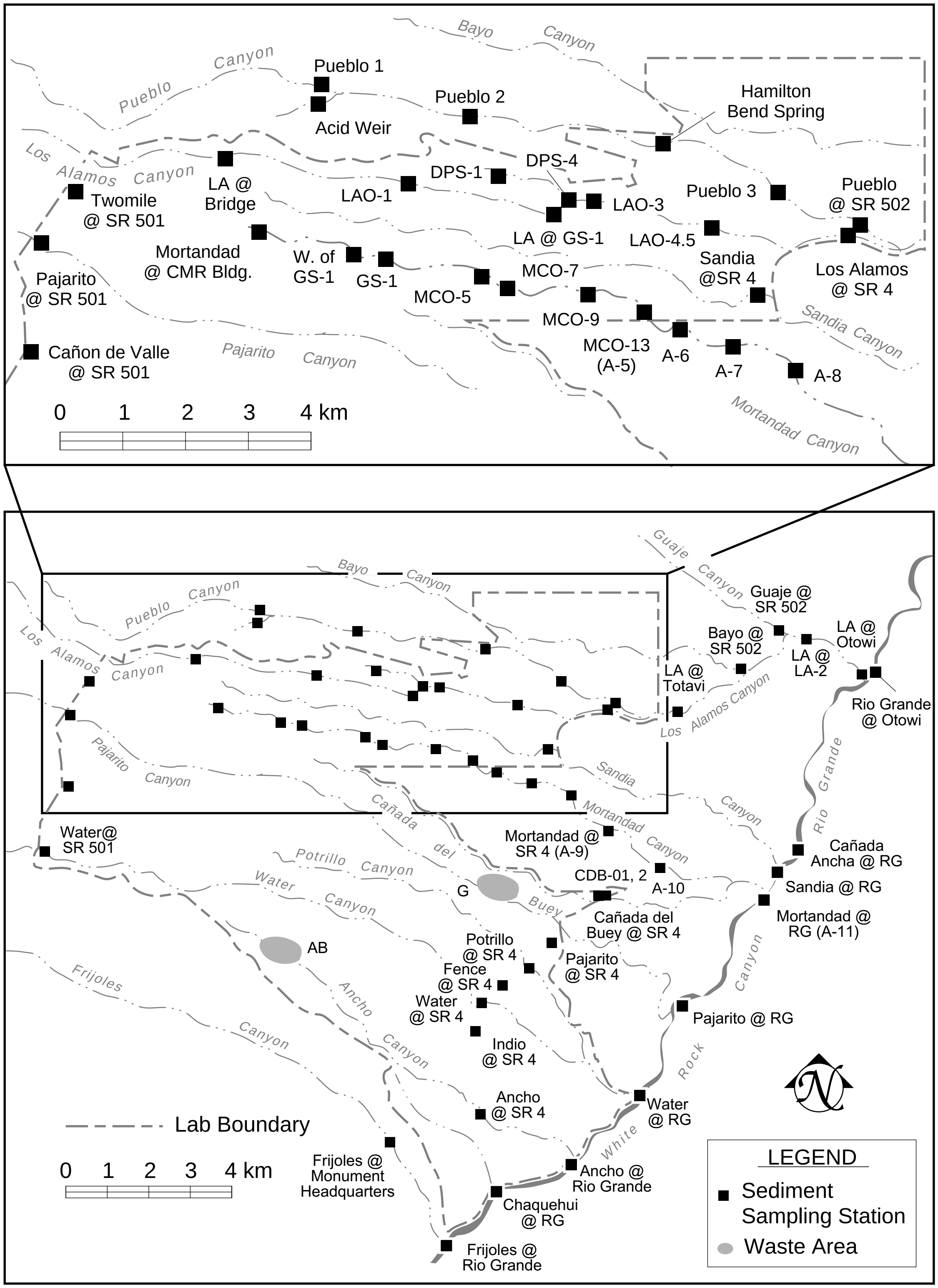


Figure 5-5. Sediment sampling stations on the Pajarito Plateau near Los Alamos National Laboratory.

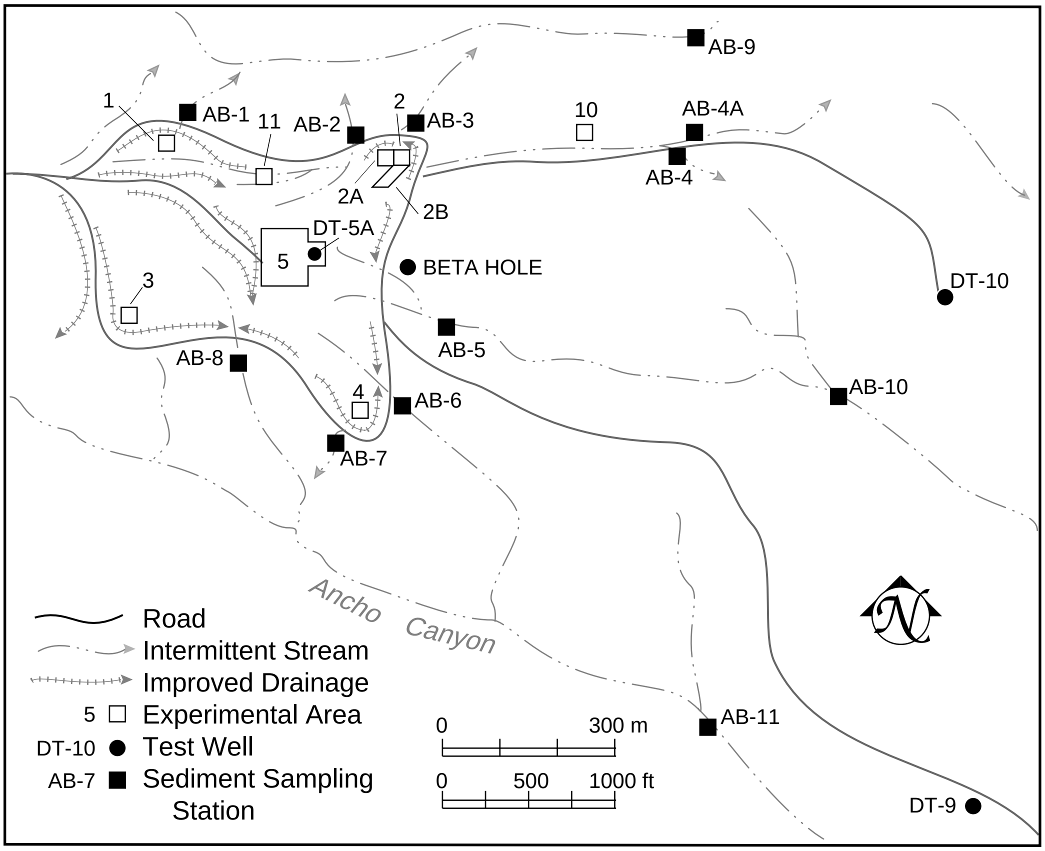


Figure 5-6. Sediment sampling stations at Technical Area 49, Area AB.

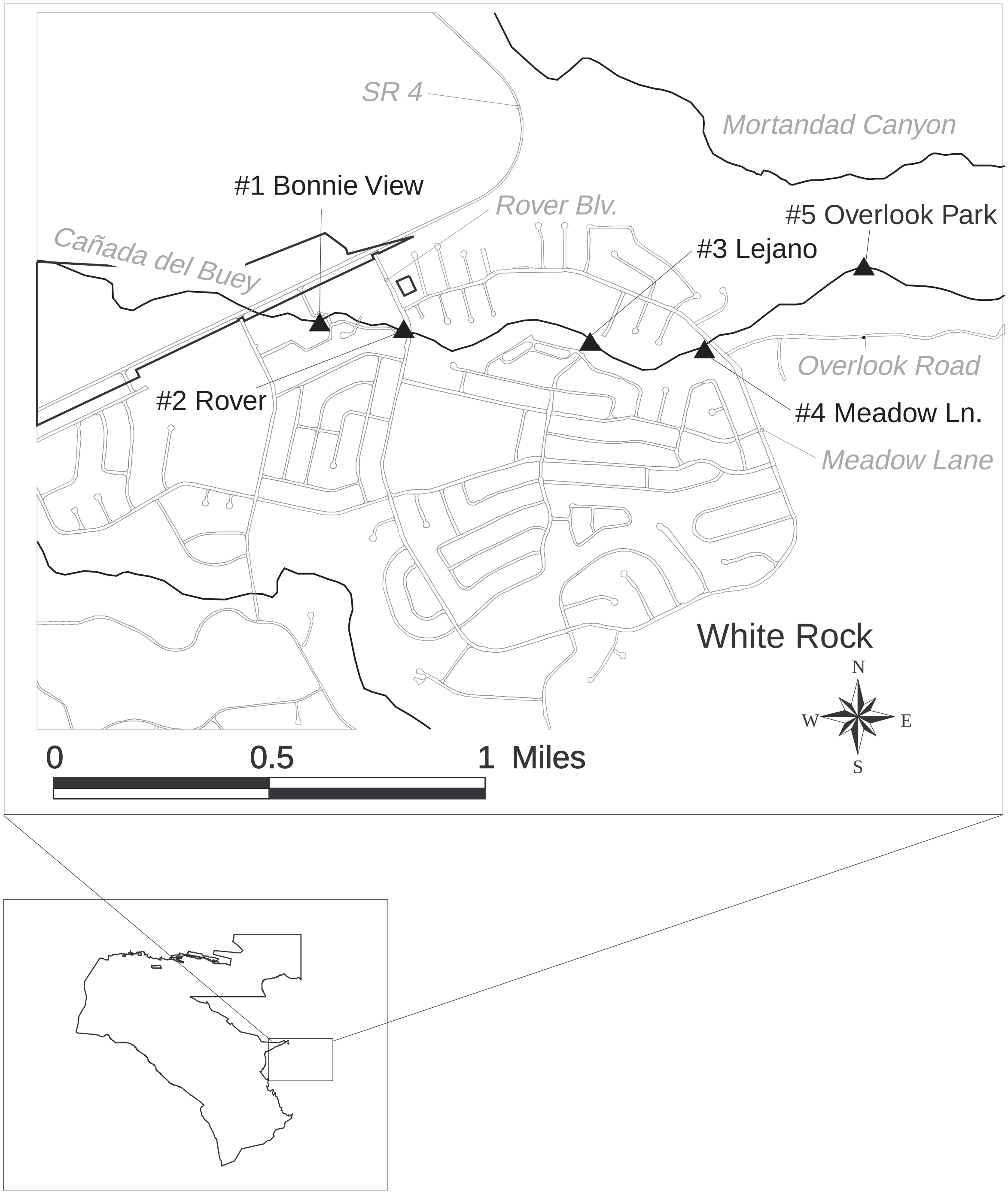


Figure 5-7. Special 1999 sediment sampling locations along Cañada del Buey in White Rock.

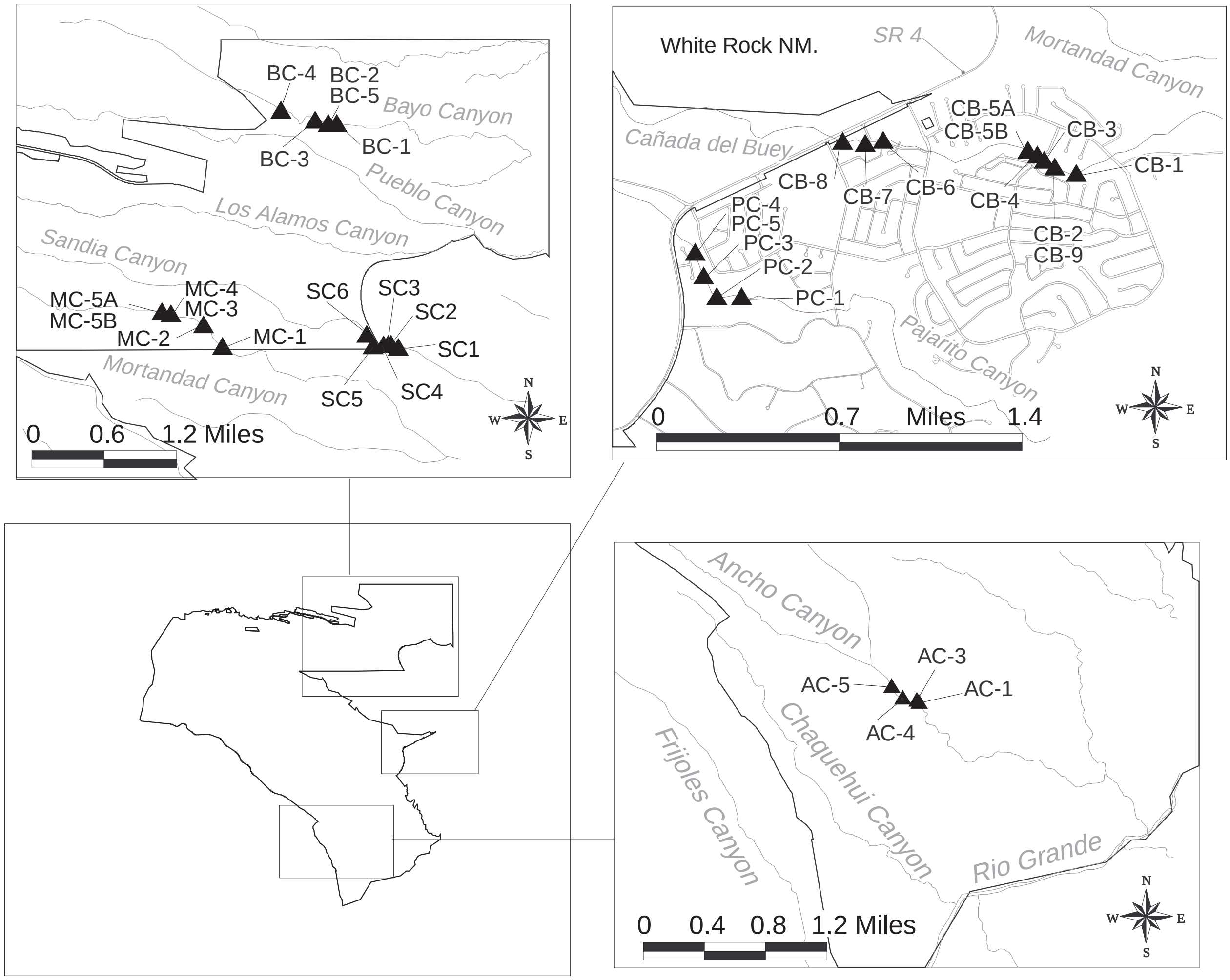
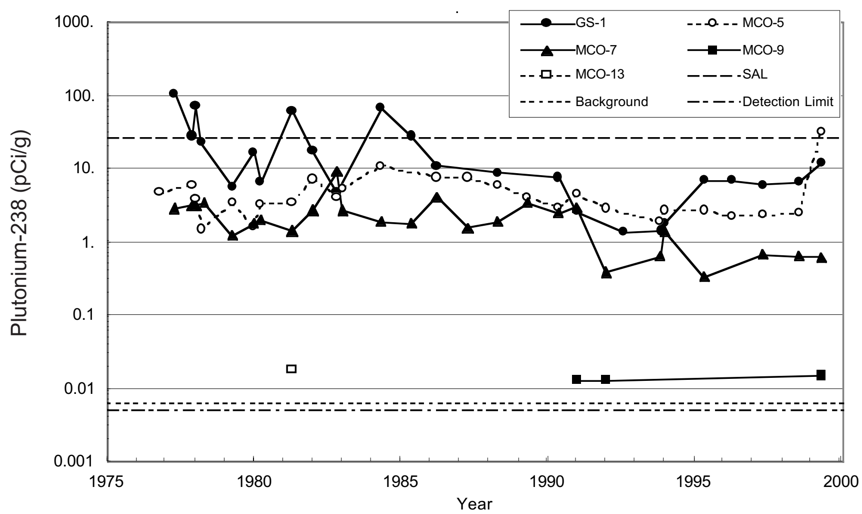
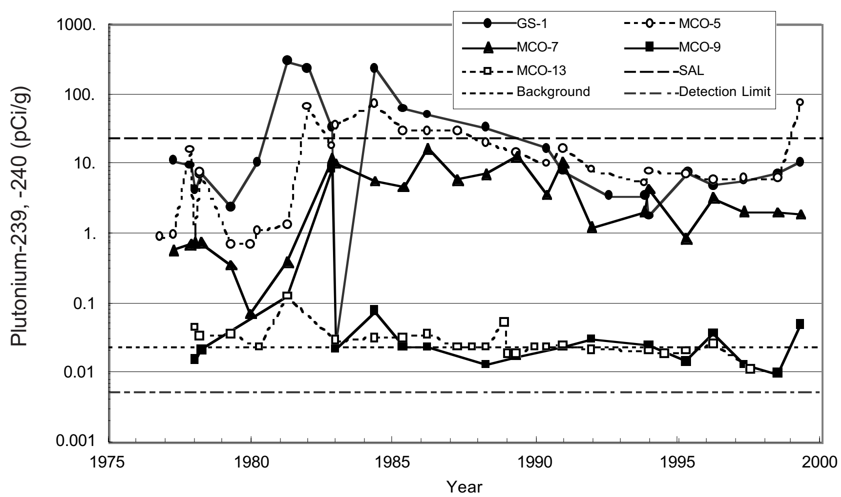


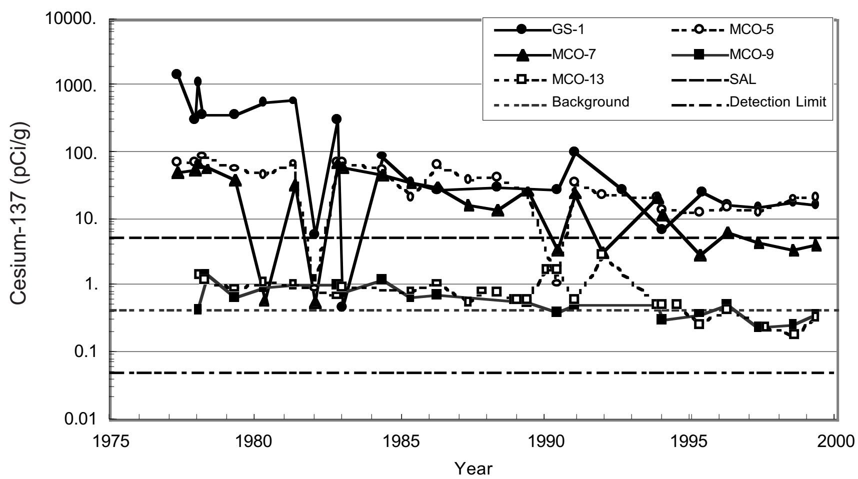
Figure 5-8. Special EPA sediment sampling stations for 1999.



a. Plutonium-238 on Laboratory lands in Mortandad Canyon.



b. Plutonium-239, -240 on Laboratory lands in Mortandad Canyon.



c. Cesium-137 on Laboratory lands in Mortandad Canyon.

Figure 5-9. Sediment radioactivity histories for stations located on Laboratory lands in Mortandad Canyon. Only detections are shown, although data are available for most years.

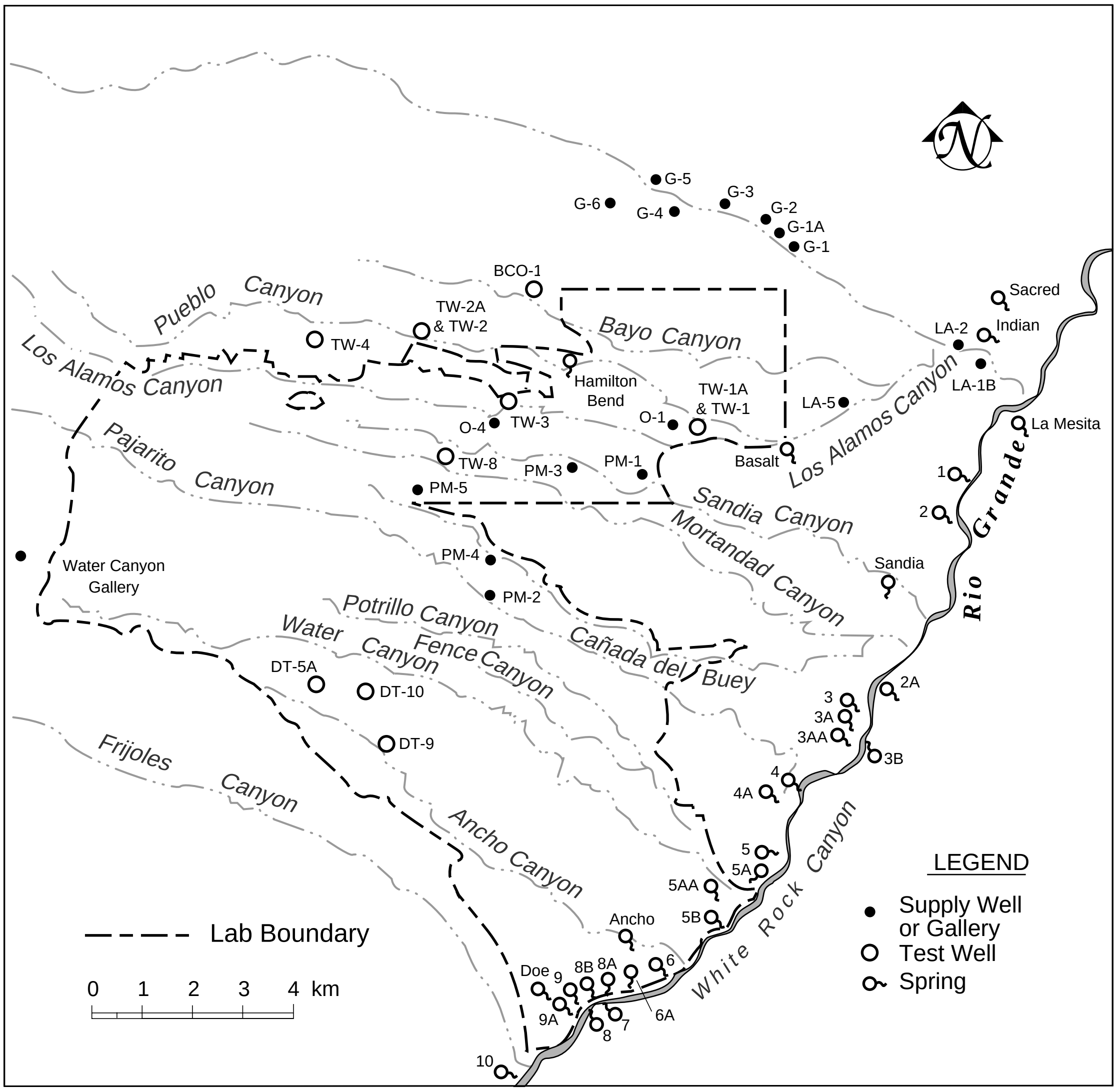


Figure 5-10. Springs and deep and intermediate wells used for groundwater sampling.

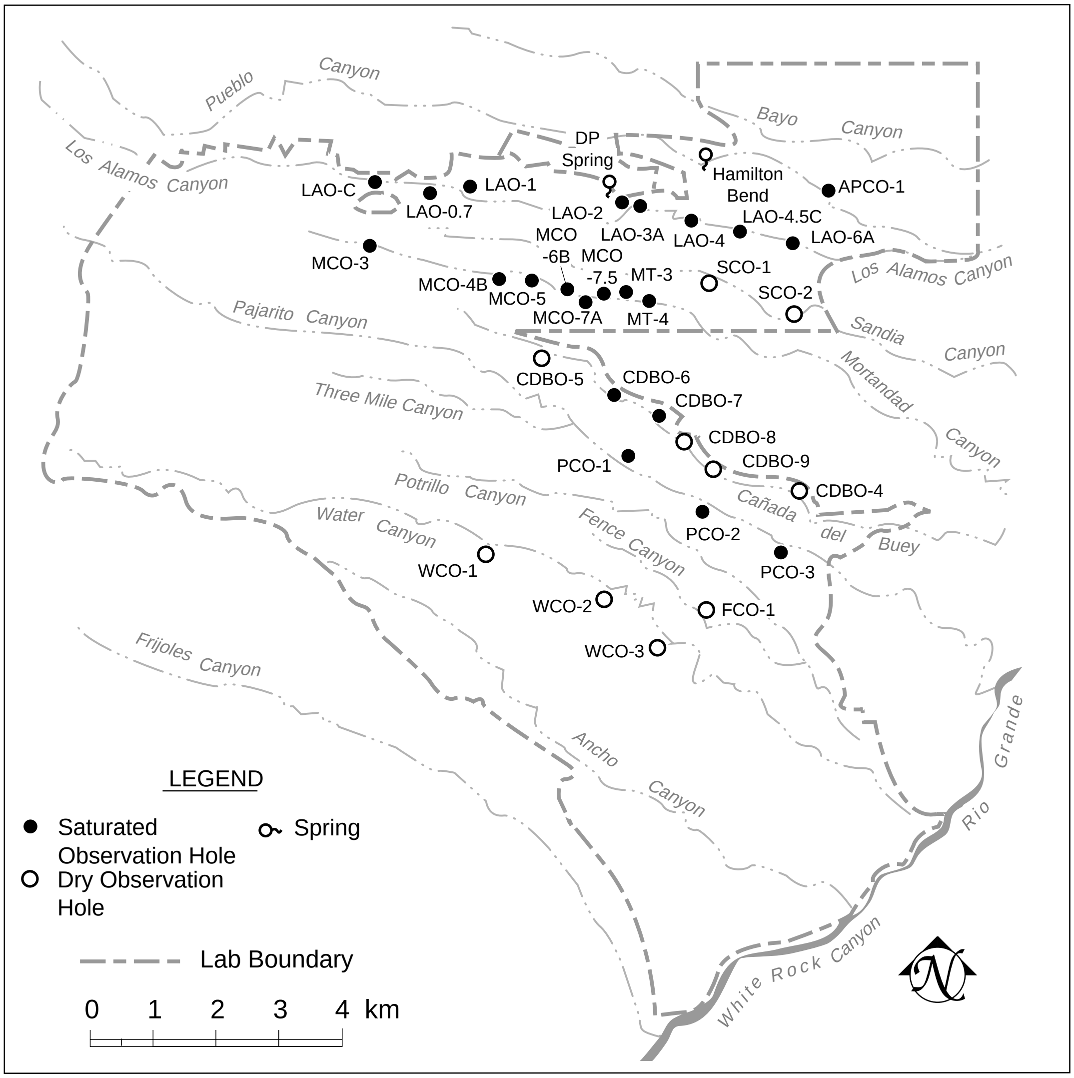
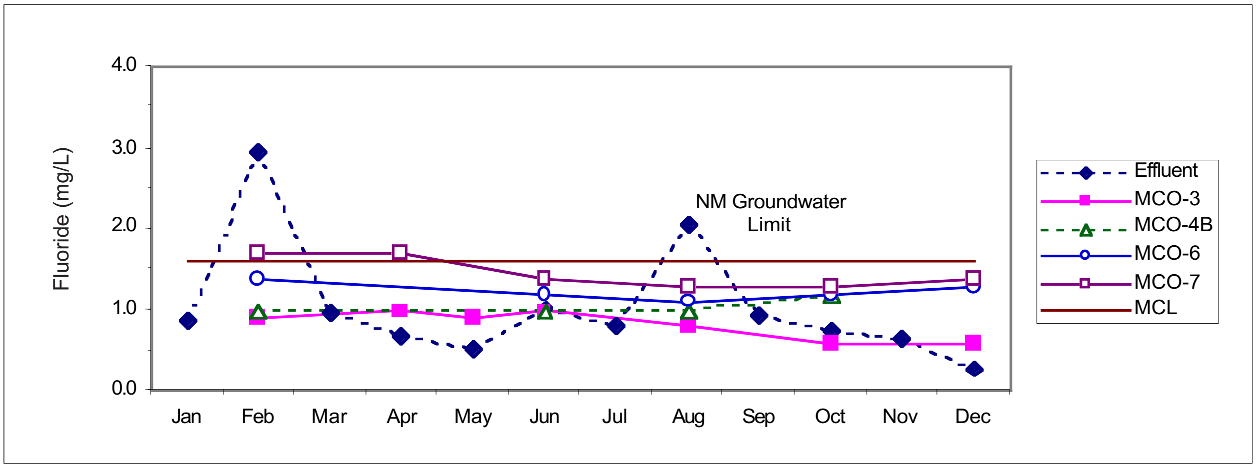
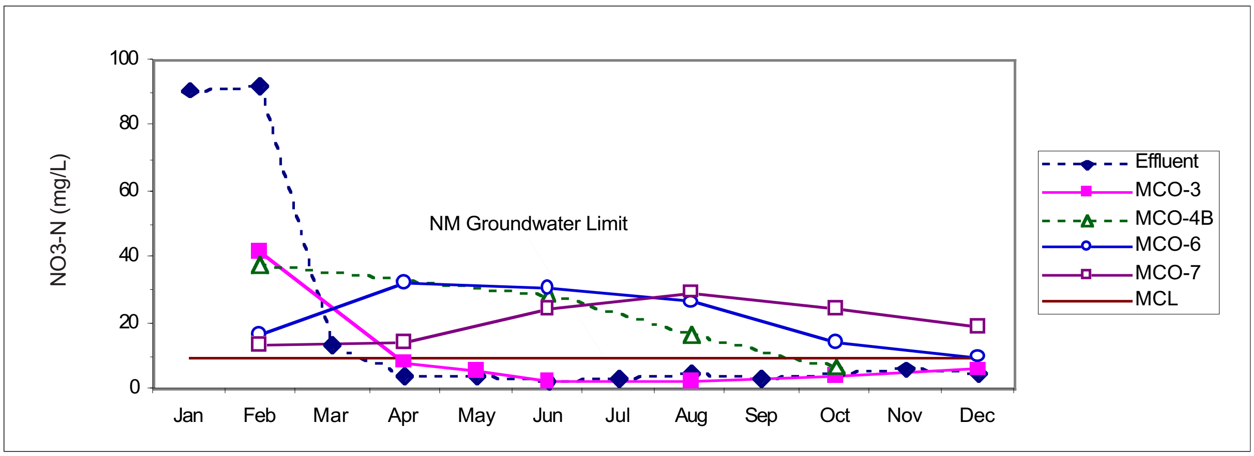


Figure 5-11. Observation wells and springs used for alluvial groundwater sampling.

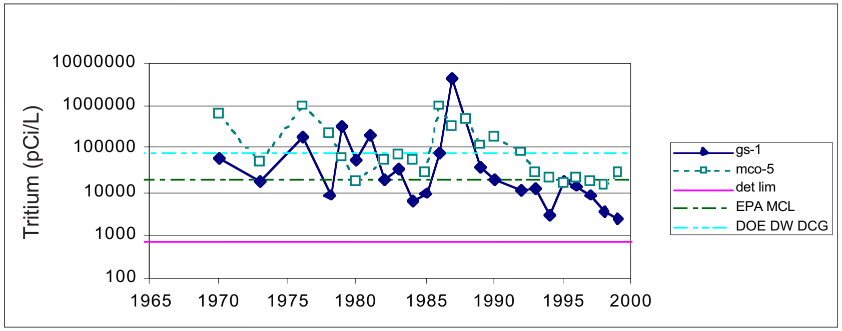


a. Fluoride

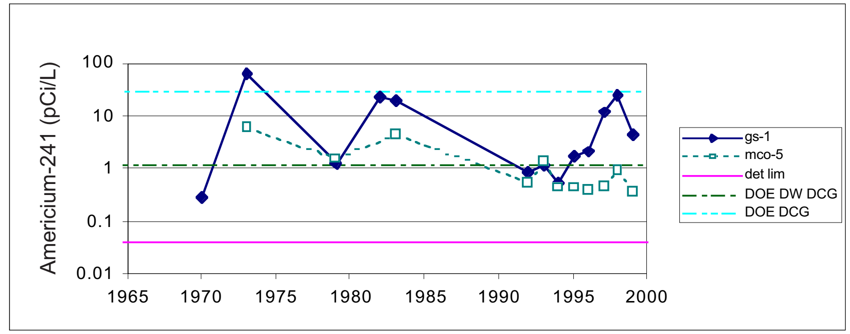


b. Nitrate

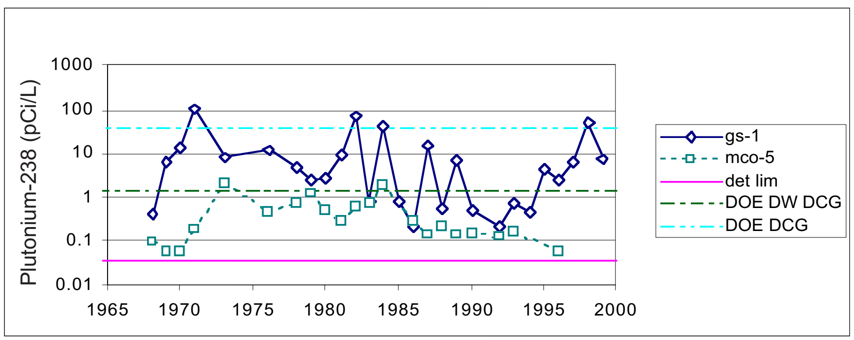
Figure 5-12. Fluoride and nitrate in Mortandad Canyon alluvial groundwater in 1999.



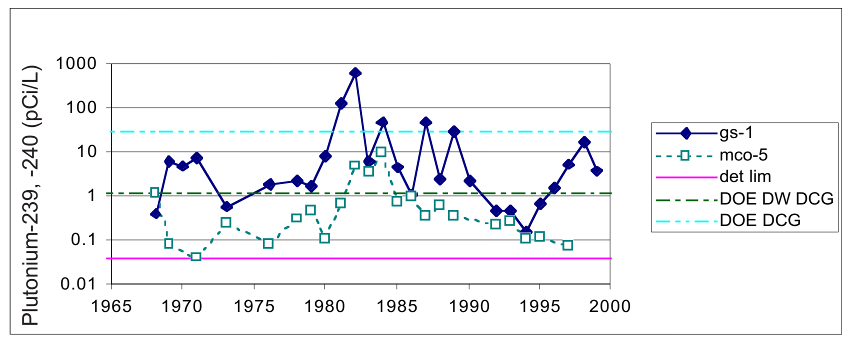
a. Mortandad Canyon tritium



b. Mortandad Canyon americium-241



c. Mortandad Canyon plutonium-238



d. Mortandad Canyon plutonium-239, -240

Figure 5-13. Annual average radioactivity in surface water and groundwater from Mortandad Canyon.

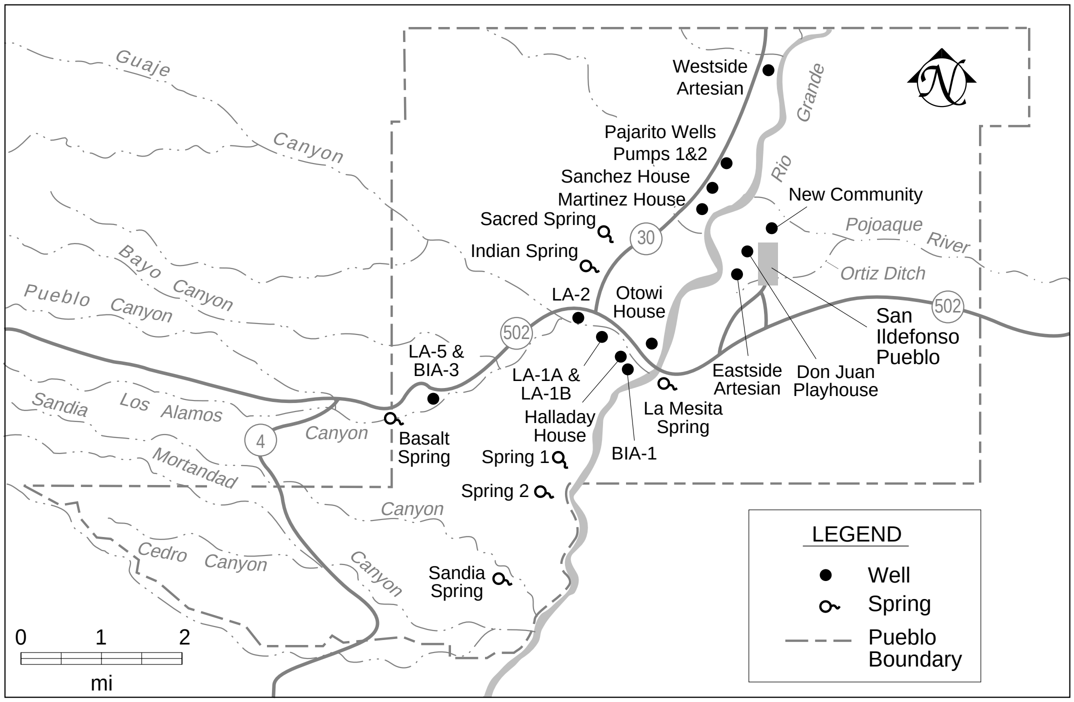


Figure 5-14. Springs and groundwater stations on or adjacent to San Ildefonso Pueblo land.

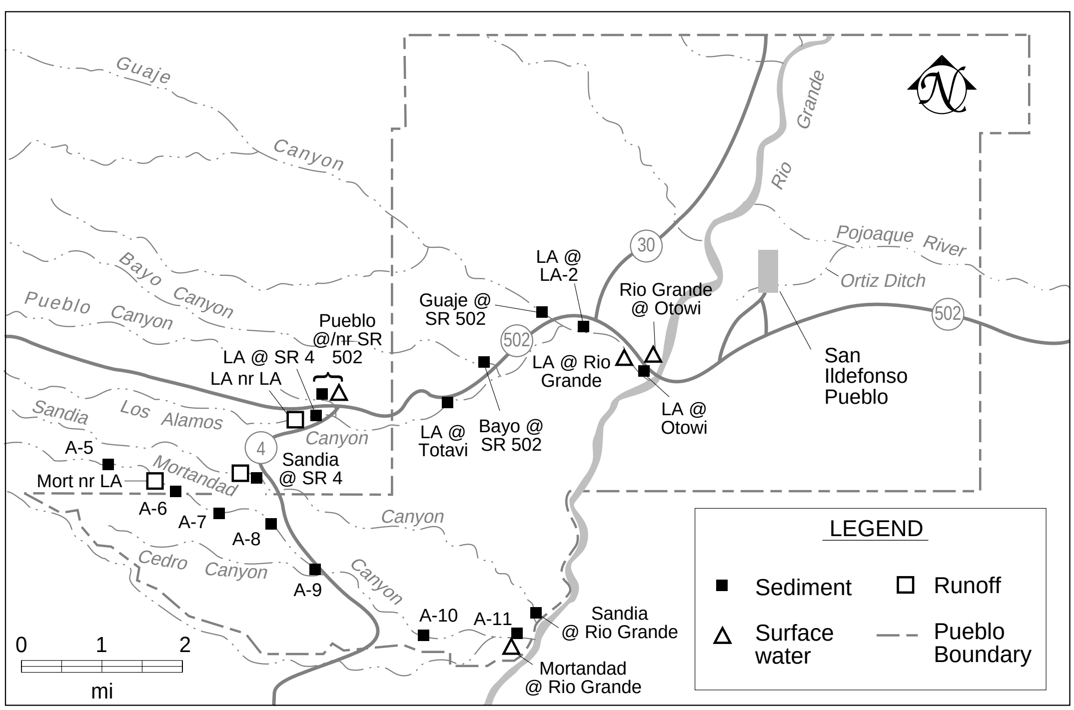


Figure 5-15. Sediment and surface water stations on or adjacent to San Ildefonso Pueblo land.

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6. Soil, Foodstuffs, and Associated Biota

6. Soil, Foodstuffs, and Associated Biota

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Abstract

Soil samples were collected from 12 on-site (Los Alamos National Laboratory [LANL or the Laboratory]) and 10 perimeter areas around the Laboratory, analyzed for radiological and nonradiological constituents, and compared with soils collected from regional background locations in northern New Mexico. Radionuclides in soils collected from regional background areas are presumably from natural sources and/or worldwide fallout. Most radionuclide concentrations in soils collected from on-site and perimeter areas were nondetectable (where the analytical results were less than three counting uncertainties) and/or within the upper range of background concentrations. Soils were also analyzed for trace elements, and most constituents, with the exception of lead in perimeter soils, were within background mean concentrations; lead concentrations, however, were well below LANL screening action levels.

Samples of foodstuffs and associated biota (produce, eggs, milk, fish, elk, deer, beef cattle, herbal tea, piñon, honey, and wild spinach) were collected from Laboratory and/or surrounding perimeter areas, including several Native American Pueblo communities, to determine the impact of LANL operations on the human food chain. In addition, biota (nonfoodstuffs) samples (understory and overstory vegetation and alfalfa forage) were collected. All radionuclides in foodstuffs and biota collected from the Laboratory and perimeter locations were low and, for the most part, were indistinguishable from worldwide fallout and/or natural sources. Plutonium-238 concentrations in produce collected from all perimeter sites, albeit low, were statistically higher than background concentrations and were higher than in past years. All trace elements, including lead, in produce collected from Laboratory and perimeter areas were within background concentrations.

Other environmental surveillance activities and special studies associated with the soils, foodstuffs, and biota programs included the determination of radionuclides and trace elements in soil, vegetation, bees, and small and large game mammals within and around Technical Area (TA) 54, Area G (the Laboratory's primary low-level radioactive waste disposal area) and DARHT (the Laboratory's Dual Axis Radiographic Hydrodynamic Test facility). Special contaminant studies included ecological risk assessments; organics in fish collected from the Rio Grande; depleted uranium effects on aquatic organisms; resource use, activity patterns, and disease analysis of elk; and polychlorinated biphenyl (PCB) concentrations in small mammals around the Laboratory. We also monitored reptiles, amphibians, and forest fire (fuel) risk to the Los Alamos region.

To Read About — **Turn to Page**

A. Soil Monitoring

1. Introduction

A soil sampling and analysis program provides the most direct means of determining the concentration/activity, inventory, and distribution of radionuclides and radioactivity around nuclear facilities (DOE 1991). This program is mandated by Department of Energy (DOE) Orders 5400.1 and 5400.5. Soil provides an integrating medium that can account for contaminants released to the atmosphere, either directly in gaseous effluents (such as air stack emissions) or indirectly from resuspension of on-site contamination (such as firing sites and waste disposal areas) or through liquid effluents released to a stream that is subsequently used for irrigation (Purtymun et al., 1987). The knowledge gained from a soil radiological sampling program is critical for providing information about potential pathways (such as soil ingestion, food crops, resuspension into the air, and contamination of groundwater) that may result in a radiation dose to a person (Fresquez et al., 1998a).

The main objectives of this program include an evaluation of (1) radionuclides, radioactivity, and nonradionuclides (light, heavy, and nonmetal trace elements) in soils collected from regional (background) locations, around the perimeter of Los Alamos National Laboratory (LANL or the Laboratory), and on-site; (2) trends over time (that is, whether radionuclides and nonradionuclides are increasing or decreasing over time); and (3) committed effective dose equivalent (CEDE) to surrounding area residents. We compare on-site and perimeter areas with regional background areas located at such a distance from the Laboratory that their radionuclide and nonradionuclide contents are mostly due to naturally occurring elements and/or to worldwide fallout. See Chapter 3 for potential radiation doses to individuals from exposure to soils.

2. Monitoring Network

Soil surface samples (0- to 2-in. depth) are collected from relatively level, open, and undisturbed areas at regional background locations (3 sites), LANL's perimeter (10 sites), and at LANL (12 sites) (see Figure 6-1). Areas sampled at LANL are not from solid waste management units (SWMUs). Instead, the majority of on-site soil-sampling stations are located on mesa tops close to and downwind from major facilities and/or operations at LANL in an effort to assess radionuclides, radioactivity, and trace elements (light, heavy, and nonmetal) in soils that may have been contaminated as a result of air stack emissions and fugitive dust (the resuspension of dust from SWMUs and active firing sites).

The 10 perimeter stations are located within 4 km (2.5 mi) of the Laboratory. These stations reflect the soil conditions of the inhabited areas to the north (Los Alamos townsite area—four stations) and east (White Rock area and San Ildefonso Pueblo lands—four stations) of the Laboratory. The other two stations, one located on Forest Service land to the west and the other located on Park Service land (Bandelier) to the southwest, provide additional coverage. Soil samples from all these areas are compared with soils collected from regional background locations in northern New Mexico surrounding the Laboratory where radionuclides, radioactivity, and trace elements are from natural and/or worldwide fallout events; these areas are located around Embudo to the north, Cochiti to the south, and Jemez to the southwest. All are more than 32 km (20 mi) from the Laboratory and are beyond the range of potential influence from normal Laboratory operations (DOE 1991).

3. Sampling Procedures, Data Management, and Quality Assurance

Collection of samples for chemical analyses follows a set procedure to ensure proper collection, processing, submittal, and posting of analytical results. Stations and samples have unique identifiers to provide chain-of-custody control from the time of collection through analysis and reporting. All quality assurance/quality control (QA/QC) protocols, chemical analyses, data handling, validation, and tabulation can be found in the Ecology Group (ESH-20) operating procedure (OP) entitled "Soil Sampling for the Soil Monitoring Program," LANL-ESH-20-SF-OP-007, R0, 1997.

4. Radiochemical Analytical Results

Table 6-1 shows data from soils collected in 1999. Most radionuclide concentrations (activity) and radioactivity in soils collected from on-site and perimeter stations were low (pCi), and most were nondetectable (i.e., the analytical result was lower than three times the counting uncertainty = 99% confidence level) (Corely et al., 1981) and/or within regional statistical reference levels (RSRLs). The RSRL is the upper-limit background concentration (mean plus two standard deviations) (Purtymun et al., 1987) from data collected from regional background areas from 1995 through 1999 for worldwide fallout and natural sources of tritium; strontium-90; cesium-137; americium-241; plutonium-238; plutonium-239, -240; total uranium; and gross alpha, beta, and gamma radioactivity.

Strontium-90 concentrations in soils from all locations, including regional background areas, were significantly higher than in past years (ESP 1997, 1998) and appear to be positively biased; the data, therefore, were not given in Table 6-1. The reasons that strontium-90 concentrations appear to be positively biased include (1) the mean strontium-90 concentrations from all locations, including regional background areas, were 15 to 18 times higher than in past years (e.g., 1996); (2) strontium-90, which is principally a beta emitter, was higher than gross (total) beta activity in soils from most sites; (3) split samples from New Mexico Environment Department (NMED) show significantly lower concentrations similar to past years (Table 6-2); and (4) trend analysis using strontium-90 data from 1974 to 1996 shows that strontium-90 concentrations in soils from all sites were in a decreasing mode (Fresquez et al., 1998a). Instead, soil strontium-90 concentrations averaged over the past four years before 1997 for all sites were given in Table 6-1; these data were given for dose assessment purposes. Positively biased strontium-90 data are given in Table 6-2 along with split sample data from NMED for statistical comparison purposes and reference, respectively. (Note: The strontium-90 positive bias was believed to result from a laboratory analysis problem, and actions have since been taken to correct the problem.)

As a group, the average concentrations of strontium-90 (Table 6-2) and total uranium, plutonium, and gross gamma activity in soils collected from on-site and/or perimeter areas were significantly higher ($p<0.05$ = the 95% confidence level) than concentrations in soils from background locations. It should be noted that, although the concentrations of strontium-90 in soils collected from all sites appear to be positively biased, they still can be statistically compared against one another to assess the contribution of Laboratory operations, if any, because all factors associated with sampling, processing, and analysis were the same. Although the mean concentrations of these radionuclides were statistically higher than background, the differences in concentrations, including strontium-90, between the sites were very small. Also, mean concentrations/activity of all radionuclides (strontium-90 was not considered because the data are biased high) were far below LANL screening action levels (SALs). LANL SALs, developed by the Environmental Restoration Project at the Laboratory, identify the presence of contaminants of concern and are derived from a risk assessment pathway based on a 10 mrem/y dose.

The slightly higher strontium, plutonium, and gamma activity in soils from on-site and/or perimeter areas as compared with regional background locations may be, in part, due to Laboratory operations but is probably more related to worldwide fallout. Radionuclides caused by fallout vary from one area to another depending on wind patterns, elevation, and precipitation (Whicker and Schulz 1982). Typically, higher amounts of fallout occur at higher elevations that receive more precipitation. Most of the regional background areas lie at elevations of 5,600 to 6,300 ft and receive approximately 10 in. of precipitation per year (Bowen 1990), whereas the on-site and perimeter areas lie at elevations of 6,500 to 7,500 ft and receive 14 to 19 in. of precipitation per year. The higher levels of uranium detected in the soil samples collected from the on-site and perimeter areas may be a result of differences in the geology or mineralogy of the soils between the areas. Soils in the Los Alamos area are derived from Bandelier (volcanic) tuff and have higher-than-average natural uranium concentrations, ranging from 3 to 11 µg of uranium per gram of soil (Crowe et al., 1978).

5. Nonradiochemical Analytical Results

We analyzed soils for light, heavy, and nonmetal trace elements. The results of the 1999 soil-sampling program can be found in Table 6-3. In general, five out of the 11 trace elements measured in surface soils collected from regional background, perimeter, and on-site stations were below the limits of detection (LOD). Of those elements that were above the LOD, most of those in soils collected from on-site and perimeter areas were within RSRLs and were within the range of metals normally encountered in the Los Alamos area (Ferenbaugh et al., 1990) and the continental United States (Shacklette and Boerngen 1984). The RSRLs were derived from regional background locations averaged over eight years (1992–1999).

As a group, chromium concentrations in soils collected from background areas were significantly higher ($p<0.05$) than chromium in soils from both perimeter and on-site locations, and lead concentrations in soils from perimeter areas were significantly higher than background and on-site soils. The differences in lead in soils between the sites, however, were very low, and they were far below SALs.

6. Long-Term Trends

We performed a Mann-Kendal test for trend analysis on radionuclides and radioactivity in soils collected from on-site and perimeter stations from 1974 through 1996 (Fresquez et al., 1998a). Although some radionuclide and radioactivity levels were generally higher in on-site and perimeter soils when compared with background levels, most radionuclides, with the exception of plutonium-238 in soils from perimeter areas, exhibited decreasing concentrations over time. The statistically significant (but very small) increase of plutonium-238 in perimeter soils over this interval may be related to the resuspension and redistribution of global fallout. Plutonium-238 and plutonium-239, -240 in soils from background areas also exhibited statistically increasing trends; however, the plutonium levels in background soils were still well within worldwide fallout concentrations.

The decreasing concentrations of the other isotopes in soils collected from perimeter and on-site areas over time may be a result of (1) cessation of aboveground nuclear weapons testing in the early 1960s, (2) weathering (water and wind erosion and leaching), (3) radioactive decay (half-life), and (4) reductions in operations and/or better engineering controls employed by LANL. Tritium, which has a half-life of about 12 years, exhibited the greatest decrease in activity over the 20-plus-year period of this study at all three areas: background, perimeter, and on-site. Indeed, by 1996, the majority of radionuclide and radioactivity values in soils collected from both perimeter and on-site areas were statistically similar to values detected in regional background locations. It should be noted that concentrations of most radionuclides in 1999, with the exception of strontium-90 because it is positively biased, are lower or similar to concentrations in 1996.

B. Foodstuffs Monitoring

1. Introduction

A wide variety of wild and domestic edible plant, fruit, and animal products are grown and/or harvested in the area surrounding the Laboratory. Ingestion of foodstuffs constitutes a critical pathway by which radionuclides can be transferred to humans (Whicker and Schultz 1982). For this reason, we collect samples of a wide host of foodstuffs (e.g., milk, eggs, produce [wild and domestic fruits, vegetables, and grains], fish, honey, herbal teas, mushrooms, piñon, domestic animals, and large and small game animals) on a systematic basis from Laboratory property and from the surrounding communities. DOE Orders 5400.1 and 5400.5 mandate this Foodstuffs Monitoring program.

The three main objectives of the program are to determine (1) radioactive and nonradioactive (light, heavy, and nonmetal trace elements) constituents in foodstuffs from on-site LANL, perimeter, and regional background areas; (2) trends; and (3) dose. Chapter 3 presents potential radiation doses to individuals from the ingestion of foodstuffs.

2. Produce

a. Monitoring Network. We collect fruits, vegetables, and grains each year from on-site, perimeter, and regional background locations (Figure 6-2). Samples of produce are also collected from Cochiti and San Ildefonso Pueblos, which are located in the general vicinity of LANL. We compare produce from areas within and around the perimeter of LANL with produce collected from regional background gardens in northern New Mexico; these gardens are located in the Española, Santa Fe, and Jemez Pueblo areas. The regional sampling locations are far enough from the Laboratory that they are unaffected by Laboratory airborne emissions.

b. Sampling Procedures, Data Management, and Quality Assurance. Produce samples are collected from local gardens within and around the perimeter of the Laboratory in the summer and fall of each year. All QA/QC protocols, chemical analyses, data handling, validation, and tabulation can be found in the ESH-20 OP entitled, “Produce Sampling and Processing for the Foodstuffs Monitoring Program,” LANL-ESH-20-SF-OP-001, R0, 1997.

c. Radiochemical Analytical Results. See Table 6-4 for concentrations of radionuclides in produce collected from on-site, perimeter, and regional background locations during the 1999 growing season. All radionuclide concentrations in fruits and vegetables collected from on-site and perimeter areas were low, and most, with the exception of plutonium-238, were nondetectable and/or within RSRLs. Tritium data in produce from all sites appear to be negatively biased (over one-half of the samples are negative) and were not reported in Table 6-4. Data for tritium in produce collected during the 1999 growing season, instead, can be found in Table 6-5 and are given for statistical comparison purposes only. It should be noted that, although the concentrations of tritium in produce collected from all sites appear to be negatively biased, they still can be statistically compared against one another to assess contributions from Laboratory operations, if any, because all factors associated with sampling, processing, and analysis were the same.

As a group, most radionuclides, including tritium, in produce collected from on-site and perimeter areas were not significantly higher ($p<0.05$) than produce collected from regional background locations. The only radionuclide in produce that was statistically higher between sites was plutonium-238; concentrations of plutonium-238 were significantly higher in produce from all of the perimeter areas compared with regional background. The differences between sites, however, were low. The mean plutonium-238 concentration in produce from on-site areas was not significantly higher than background and significantly lower than produce from most of the perimeter areas. The fact that on-site produce was significantly lower in plutonium-238 concentrations than produce collected from the perimeter areas, however, may be a reflection of the variety of foodstuffs collected between the two sites; more fruits than vegetables were collected on LANL lands, whereas more vegetables than fruits were collected on perimeter lands. The source of the higher concentrations of plutonium-238 in produce from all of the perimeter areas is not completely known as all of the other radionuclides in produce from the perimeter areas collected this year are similar to background concentrations and are on the same order as in past years.

d. Nonradiochemical Analytical Results. The trace elements silver, arsenic, beryllium, cadmium, chromium, mercury, nickel (for the most part), selenium, and thallium in produce from on-site, perimeter, and regional background locations were below the LOD (Table 6-6). In those cases where produce samples contained trace elements above the LOD (for barium, lead, and zinc), very few individual samples exceeded RSRLs. As a group, the levels of barium, lead, and zinc in produce from on-site and perimeter areas were not significantly higher ($p<0.05$) than in produce collected from regional background areas.

3. Eggs

a. Monitoring Network. We collected fresh eggs from free-ranging chickens in the Los Alamos townsite, the White Rock/Pajarito Acres townsite, and San Ildefonso Pueblo. We compared these eggs with eggs produced from free-range chickens located in the Española area.

b. Sampling Procedures, Data Management, and Quality Assurance. We collected 24 medium-sized eggs from four locations directly from the farmer. All QA/QC protocols, chemical analyses, data handling, validation, and tabulation can be found in the ESH-20 OP entitled, “Egg Sampling and Processing for the Foodstuffs Monitoring Program,” LANL-ESH-20-SF-OP-006, R0, 1997.

c. Radiochemical Analytical Results. Table 6-7 contains the results of radionuclide concentrations in eggs collected from Los Alamos townsite, White Rock/Pajarito Acres townsite, San Ildefonso Pueblo, and Española (background) in 1999. All radionuclide concentrations in eggs collected from all locations were low, similar to past years, and most were nondetectable and/or within upper-level background concentrations. Only plutonium-238 in eggs from White Rock/Pajarito Acres was above RSRLs. The differences in plutonium-238 concentrations in eggs collected from White Rock/Pajarito Acres and background areas, however, were very low—a difference of 0.021 pCi/L.

4. Milk

a. Monitoring Network. We collected goat milk from Los Alamos and White Rock/Pajarito Acres and compared it with goat milk collected from a dairy located near Albuquerque, NM.

b. Sampling Procedures, Data Management, and Quality Assurance. We collected milk directly from the farmers. All QA/QC protocols, chemical analyses, data handling, validation, and tabulation can be found in the ESH-20 OP entitled, “Milk and Tea Sampling and Processing for the Foodstuffs Monitoring Program,” LANL-ESH-20-SF-OP-005, R0, 1997.

c. Radiochemical Analytical Results. Table 6-8 presents the results of the radiochemical analysis performed on goat milk collected from the perimeter areas and Albuquerque (background) in 1999. All radionuclides, including iodine-131, in goat milk from the perimeter areas were low and were nondetectable and/or within upper-level background concentrations. Tritium and strontium-90 levels, in particular, are similar to tritium and strontium-90 levels in milk from other states around the country (Black et al., 1995).

5. Fish

a. Monitoring Network. We collect fish annually upstream and downstream of the Laboratory (Figure 6-2). Cochiti Reservoir, a 10,690-acre flood and sediment control project, is located on the Rio Grande approximately five miles downstream from the Laboratory. We compared radionuclides and nonradionuclides (mostly mercury) in fish collected from Cochiti Reservoir with fish collected from background reservoirs. These background reservoirs are the Abiquiu, Heron, and El Vado Reservoirs, which are located on the Rio Chama, upstream from the confluence of the Rio Grande and intermittent streams that cross Laboratory lands (Fresquez et al., 1994).

The samples include two types of fish: game and nongame (bottom-feeders). Game fish include rainbow trout, brown trout, kokanee salmon, largemouth bass, smallmouth bass, white crappie, and walleye. Nongame fish include the white sucker, channel catfish, carp, and carp sucker.

b. Sampling Procedures, Data Management, and Quality Assurance. Fish were collected by gill nets and transported under ice to the laboratory for preparation. At the laboratory, fish were gutted, had head and tail removed, and were washed. Muscle (plus associated bone) tissue for radiochemical analysis is submitted as ash, and muscle (filet) is submitted in a wet frozen state for mercury analysis. All QA/QC protocols, chemical analyses, data handling, validation and tabulation can be found in the ESH-20 OP entitled, "Fish Sampling and Processing for the Foodstuffs Monitoring Program," LANL-ESH-20-SF-OP-002, R0, 1997.

c. Radiochemical Analytical Results. Table 6-9 presents concentrations of radionuclides in game and nongame fish collected upstream and downstream of the Laboratory in 1999. The data sets for tritium and americium-241 in fish from both reservoirs appear to be negatively biased and were not presented in Table 6-9. Instead, these data are given in Table 6-10 for statistical comparison purposes only.

In general, all radionuclides in game and nongame fish collected from Cochiti Reservoir were low, and most were nondetectable and/or within upper-level background concentrations. These results were similar to radionuclide contents in crappie, trout, and salmon from comparable (background) reservoirs and lakes in Colorado (Whicker et al., 1972; Nelson and Whicker 1969) and, more recently, in fish collected along the length of the Rio Grande from Colorado to Texas (Booher et al., 1998) and from the confluences of some of the major canyons that cross LANL lands with the Rio Grande (Fresquez et al., 1999c).

Although the concentrations of tritium and americium-241 in fish collected from Cochiti and Abiquiu Reservoirs appear to be negatively biased, they still can be statistically compared against one another to assess contributions from Laboratory operations, if any, because all factors associated with sampling, processing, and analysis were the same. Accordingly, both game and nongame fish collected downstream of LANL at Cochiti reservoir were not significantly higher ($p<0.05$) in radionuclide concentrations, including tritium and americium-241, than were fish collected upstream of LANL at Abiquiu Reservoir.

As expected, the nongame fish from both downstream and upstream reservoirs from LANL contained higher average uranium contents (15.2 ng per dry gram) than the surface-feeders (3.8 ng per dry gram). The higher concentration of uranium in bottom-feeding fish compared with surface-feeding fish is attributed to the ingestion of sediments on the bottom of the lake (Gallegos et al., 1971). Radionuclides readily bind to sediments (Whicker and Schultz 1982).

d. Long-Term (Radionuclide) Trends. Fresquez et al. (1994) conducted a summary and trend analysis of radionuclides in game and nongame fish collected from reservoirs upstream (Abiquiu, Heron, and El Vado Reservoirs) and downstream (Cochiti Reservoir) of LANL from 1981 to 1993. In general, the average levels of strontium-90; cesium-137; plutonium-238; and plutonium-239, -240 in game and nongame fish collected from Cochiti Reservoir were not significantly different from concentrations in fish collected from reservoirs upstream of the Laboratory. Total uranium was the only radionuclide that was found to be significantly higher in both game and nongame fish from Cochiti Reservoir when compared with fish from Abiquiu, Heron, and El Vado Reservoirs. Uranium concentrations in fish collected from Cochiti Reservoir, however, significantly ($p<0.05$) decreased from 1981 to 1993, and we found no evidence of depleted uranium in fish samples collected from Cochiti Reservoir in 1993 (Fresquez and Armstrong 1996). Concentrations of most radionuclides in fish collected in 1999 are similar to radionuclides in fish collected in 1993. Other fish studies in the area around LANL for long-term reference include Fresquez et al. (1996) and Fresquez et al. (1998c).

e. Nonradiological Analytical Results. The results of the trace element analysis in fish samples from Cochiti and Abiquiu Reservoirs in past years showed that mercury was the only element to be detected above the minimum level of detection (Table 6-11). All concentrations of mercury in fish from Cochiti Reservoir collected in 1999 were within the RSRL (<0.41µg mercury per wet gram), and fish collected from Abiquiu Reservoir were significantly higher ($p<0.05$) in mercury concentrations than fish collected downstream of the Laboratory at Cochiti Reservoir.

f. Long-Term (Nonradiological) Trends. Fresquez et al. (1999e) conducted a summary and trend analysis of major trace elements, with special reference to mercury, in game and nongame fish collected from Abiquiu, Heron, and El Vado Reservoirs upstream of LANL (hereafter referred to collectively as Abiquiu) and Cochiti Reservoir downstream of LANL from 1991 to present. With the exception of mercury, most trace elements in fish collected from Abiquiu and Cochiti over a nine-year period were below the LOD. Mean mercury concentrations in all years in fish from Abiquiu, upstream of LANL, were generally higher than mercury concentrations in fish from Cochiti, and the statistical analysis of the mean of means showed that mercury in fish from Abiquiu was significantly higher ($p<0.10$) than mercury in fish collected from Cochiti. The highest individual mercury concentrations [1.0 µg/g wet weight] were detected in a single catfish each from Abiquiu and Cochiti in 1994, and the only carnivorous fish collected, brown trout from Abiquiu and white crappie from Cochiti in 1991, contained 0.30 and 0.36 µg/g wet weight of mercury, respectively.

Mean concentrations of mercury in fish from both Abiquiu and Cochiti were within mercury concentrations typical of fish from nonpolluted fresh water systems (Abernathy and Cumbie 1977) and below the US Food and Drug Administration's ingestion limit of 1 µg mercury/g wet weight (Torres 1998). Concentrations of mercury in catfish from this study were very similar to mercury levels in catfish recently collected from Conchas Lake, which averaged 0.25 µg/g wet weight, and Santa Rosa Lake, which ranged from 0.22 to 0.33 µg/g wet weight (Bousek 1996; Torres 1998). These authors concluded that health risks to the average sport fisherman posed by mercury in fish from Conchas and Santa Rosa Lakes were negligible.

Overall, mean mercury concentrations in fish collected from both reservoirs show significantly decreasing trends over time; Abiquiu ($p = 0.045$) was significant at the 0.05 probability level and Cochiti ($p = 0.066$) was significant at the 0.10 probability level. It is not completely known why concentrations of mercury are decreasing in fish collected from Abiquiu and Cochiti, but the reduction of emissions in coal-burning power plants and/or the reduction of carbon sources within the reservoirs may be part of the reason. Since the early 1980s, for example, coal-burning power plants in the northwest corner of New Mexico have been required to install venturi scrubbers and baghouses to capture particulates and reduce air emissions (Martinez 1999). Additionally, because the conversion of mercury to methyl mercury is primarily a biological process, it has been demonstrated that mercury concentrations in fish tissue rise significantly in impoundments that form behind new dams and then gradually decline to an equilibrium level as the carbon provided by flooded vegetation is depleted (NMED 1999).

6. Game Animals (Elk and Deer)

a. Monitoring Network. Mule deer and Rocky Mountain elk are common inhabitants of LANL. Resident populations of deer number from 50 to 100; elk number from 100 to 200 and increase to as many as 2,000 animals during the winter months (Fresquez et al., 1999d). We collected samples of elk and deer as roadkill on an annual basis from Laboratory areas and analyzed the meat and bone for a host of radionuclides. We compared these data from meat and bone samples with radionuclide concentration in meat and bone samples from elk and deer collected from regional background locations.

b. Sampling Procedures, Data Management, and Quality Assurance. We collected samples of elk and deer meat and bone tissue (1000 g each) from fresh roadkills around and within the Laboratory. The New Mexico Department of Game and Fish collected background samples. All QA/QC protocols, chemical analyses, data handling, validation, and tabulation can be found in the ESH-20 OP entitled, "Game Animal Sampling and Processing for the Foodstuffs Monitoring Program," LANL-ESH-20-SF-OP-003, R0, 1997.

c. Radiochemical Analytical Results. All radionuclide concentrations in muscle and bone tissue of elk collected from LANL lands were nondetectable and/or below upper-level background concentrations and were within concentrations from past years (Fresquez et al., 1998b) (Table 6-12).

Most radionuclide concentrations in muscle and bone tissue of a deer collected from LANL lands were nondetectable and/or within RSRLs and were within concentrations from past years (Fresquez et al., 1998b) (Table 6-13). Only one element, strontium-90 in bone tissue, was detected in concentrations above the RSRL; the differences in strontium-90 concentrations in bone tissues between the LANL deer and background deer, however, were small.

d. Long-Term Trends. A 1998 report summarized radionuclide concentrations (tritium; strontium-90; cesium-137; plutonium-238 and plutonium-239, -240; americium-241; and uranium) determined in muscle and bone tissue of deer and elk collected from LANL lands from 1991 through 1998 (Fresquez et al., 1998b). Also, we estimated the CEDE to people who ingest muscle and bone from deer and elk collected from LANL lands. Most radionuclide concentrations in muscle and bone from individual deer and elk collected from LANL lands were at less than detectable quantities and/or within upper-level background concentrations. As a group, most radionuclides in muscle and bone of deer and elk from LANL lands were not significantly higher ($p<0.10$ = at the 90% confidence level) than in similar tissues from deer and elk collected from background locations. Also, elk that had worn radio collars and been tracked for two years that spent an average time of 50% on LANL lands were not significantly different in most radionuclide levels from roadkill elk that have been collected on LANL lands as part of the environmental surveillance program. All CEDEs were far below the International Commission on Radiological Protection guideline of 100 mrem/yr.

7. Domestic Animals (Beef Cattle)

a. Monitoring Network. Beef cattle owned by San Ildefonso Pueblo graze the boundaries of LANL on a regular basis and are offered by the Pueblo for sampling and analysis. We compared meat and bone tissue collected from these cattle sampled from San Ildefonso Pueblo with similar tissues from beef cattle collected from regional background locations.

b. Sampling Procedures, Data Management, and Quality Assurance. All QA/QC protocols, chemical analyses, data handling, validation, and tabulation can be found in the ESH-20 OP entitled, "Game Animal Sampling and Processing for the Foodstuffs Monitoring Program," LANL-ESH-20-SF-OP-003, RO, 1997.

c. Radiochemical Analytical Results. Table 6-14 shows radionuclide concentrations in muscle and bone tissue of domestic free-range beef cattle collected from San Ildefonso Pueblo and regional background. Most radionuclides in muscle and bone tissue from these cattle were low and were nondetectable and/or within upper-limit background concentrations. The only radionuclides that were above RSRLs were strontium-90 and plutonium-238 in muscle and bone and plutonium-239 in bone from the San Ildefonso animal. For the most part, concentrations of these (detectable) elements were just above RSRLs, and the differences between these elements in muscle and bone from animals collected from San Ildefonso Pueblo compared with livestock from regional background locations were low.

8. Herbs/Tea

a. Monitoring Network. We collected Navajo Tea (also known as Cota) from three perimeter areas surrounding the Laboratory: Los Alamos townsite on the north, White Rock on the southeast, and San Ildefonso Pueblo lands on the east. We collected tea from the Española, Santa Fe, and Jemez areas as a background comparison.

b. Sampling Procedures, Data Management, and Quality Assurance. Tap water was added to the vegetative (unwashed) portion (stems) of Navajo Tea and brought to a boil. After the tea cooled, it was filtered and poured into a suitable container and submitted to chemistry as a liquid. All QA/QC protocols, chemical analyses, and data handling, validation, and tabulation can be found in the ESH-20 OP entitled, "Milk and Tea Sampling and Processing for the Foodstuffs Monitoring Program," LANL-ESH-20-SF-OP-005, R0, 1997.

c. Radiochemical Analytical Results. See Table 6-15 for results of the liquid tea analysis during 1999. All radionuclides in tea collected from the perimeter areas around LANL were nondetectable and/or within upper-limit background concentrations. Last year (1998), total uranium in Navajo Tea from all of the perimeter and background locations was detected in higher concentrations than the previous year's results. This year, uranium results in teas collected from all of the areas, including the control, are similar to past years, so the uranium results in 1998 were probably a result of chemical bias.

9. Piñon

a. Monitoring Network. Because piñon pine nuts are produced every 7 to 10 years by piñon pine trees in the semiarid Southwest, piñon pine shoot tips (a more conservative medium) have been harvested in the past on an annual basis since 1996 in an effort to estimate the dose from the ingestion of this very popular native product. In 1998, we had a piñon pine nut crop on LANL property and are reporting these results here along with piñon pine shoots we collected in 1999.

For piñon pine shoot tips, we collected samples from three perimeter areas surrounding the Laboratory: Los Alamos townsite on the north, White Rock/ Pajarito Acres on the southeast, and San Ildefonso Pueblo lands on the east. Piñon pine shoot tips collected from the Jemez area provided background comparisons. For piñon pine nuts, we collected samples from two study sites: (1) LANL (Technical Areas [TA]-15, -36, -39, and -49) and (2) regional background locations (Tres Piedras, Jemez, and Coyote, NM).

b. Sampling Procedures, Data Management, and Quality Assurance. Both piñon pine shoot tips and nuts were washed. Piñon pine nuts were also shelled. All QA/QC protocols, chemical analyses, data handling, validation, and tabulation can be found in the ESH-20 OP entitled, "Produce Sampling and Processing for the Foodstuffs Monitoring Program," LANL-ESH-20-SF-OP-001, R0, 1997.

c. Radiochemical Analytical Results. Table 6-16 provides analytical results of the piñon pine shoot tips collected during 1999. Most radionuclides in piñon pine shoot tips from the perimeter areas of LANL were present in very low concentrations and were nondetectable and/or within RSRLs. Cesium-137 detected in piñon pine shoots from White Rock/Pajarito Acres was the only element that was higher than the RSRL. The differences in cesium-137 in piñon pine shoot tips from White Rock/Pajarito Acres and background, however, were very low (0.019 pCi/g dry).

Analytical results of the piñon pine nuts can be found in Table 6-17. All radionuclides in piñon pine nuts collected from LANL lands were nondetectable and/or within RSRLs. Strontium-90 in piñon pine nuts appeared to be negatively biased and was not reported in Table 6-17; instead, the data are given in Table 6-18. Although the concentrations of strontium-90 in piñon pine nuts collected from both LANL and regional background appear to be negatively biased, they still can be statistically compared against one another to assess contributions from Laboratory operations, if any, because all factors associated with sampling, processing, and analysis were the same. Accordingly, as a group, radionuclides, including strontium-90, in piñon pine nuts collected on LANL lands were not significantly higher ($p<0.10$) than radionuclides in nuts from regional background locations (Fresquez et al., 2000).

Comparing radionuclide concentrations in piñon pine nuts collected from LANL lands in 1977 (n = 6 sites) (Salazar 1979) with piñon pine nuts collected in the present study shows that most of the radionuclides, with the exception of cesium-137, in piñon pine nuts collected in this study were lower than in piñon pine nuts collected over 20 years ago. It should be noted that Salazar's radionuclide data, with the exception of tritium, were incorrectly presented as being on a dry weight basis. These data were really listed in units per ash weight. We converted the data to a dry weight basis by multiplying the average by the ash/dry weight ratio of piñon pine nuts (0.026) (Fresquez and Ferenbaugh, 1999) for comparison to the present study. Accordingly, the average concentration of tritium decreased slightly from 13 to 10 pCi/mL, strontium-90 from 0.009 to –0.012 pCi/g dry, total uranium from 5.5 to 1.3 ng/g dry, plutonium-238 from –0.0009360 to –0.0000026 pCi/g dry, and plutonium-239 from 0.0009022 to 0.0000312 pCi/g dry. In contrast, the average concentration of cesium-137 in piñon pine nuts from LANL in 1977 slightly increased from 0.0002 to 0.0040 pCi/g dry in 1998.

10. Wild Spinach

a. Monitoring Network. We collected wild spinach from LANL and three perimeter areas: Los Alamos townsite on the north, White Rock/Pajarito Acres on the southeast, and San Ildefonso Pueblo lands on the east. We also collected spinach from the Española, Santa Fe, and Jemez area as a background comparison.

b. Sampling Procedures, Data Management, and Quality Assurance. All QA/QC protocols, chemical analyses, data handling, validation, and tabulation can be found in the ESH-20 OP entitled, "Produce Sampling and Processing for the Foodstuffs Monitoring Program," LANL-ESH-20-SF-OP-001, R0, 1997.

c. Radiochemical Analytical Results. Table 6-19 contains the analytical results of the wild spinach collected during 1999. All radionuclides in wild spinach collected from the perimeter sites were nondetectable and/or within upper-level background concentrations, and most, with the exception of strontium-90, were in similar concentrations to past years (ESP 1996). The concentration of strontium-90 in spinach collected at all of the sites in 1995 was 0.063 pCi/g dry, whereas the concentration of strontium-90 in spinach in 1999 was 0.200 pCi/g dry.

d. Nonradiochemical Analytical Results. Most trace elements in wild spinach from the perimeter areas were below the LODs (Table 6-20). Of the trace elements that were above the LODs, most were similar to trace elements in spinach collected from background locations. Wild spinach collected from the Los Alamos townsite contained nickel and lead concentrations higher than the upper-level background concentrations for general produce; the differences, however, were low.

11. Honey

a. Monitoring Network. Beehives located within perimeter areas—Los Alamos townsite and White Rock/Pajarito Acres—are sampled on a biannual basis for honey and were last sampled during the 1997 year (Figure 6-2). We compared honey from those hives with honey collected from regional background hives located in northern New Mexico.

b. Sampling Procedures, Data Management, and Quality Assurance. We collected honey directly from the producer in their bottles. All QA/QC protocols, chemical analyses, data handling, validation and tabulation can be found in the ESH-20 OP entitled, "Honey Sampling and Processing for the Foodstuffs Monitoring Program," LANL-ESH-20-SF-OP-004, RO, 1997.

c. Radiochemical Analytical Results. See Table 6-21 for the analytical results of the honey collected during 1999. Most radionuclide concentrations in honey collected from perimeter hives were nondetectable and/or within upper-level background concentrations and were in concentrations similar to past years (Fresquez et al., 1997a; Fresquez et al., 1997b). Most of the honey collected from the Los Alamos townsite hive was lost in analysis; apparently, the Los Alamos townsite sample was lost during the tritium distillation process, and the remaining portion may have been (cross) contaminated in the analytical laboratory before the analysis of the other radionuclides (George Brooks, CST-9 Radiochemist, personal communication, April 10, 2000).

Honey from bee hives in the Los Alamos townsite in past years (ESP 1996 and 1997) showed no influence from Laboratory operations, save for tritium (Fresquez et al., 1997b), and honey from the other hive collected during 1999 (White Rock/Pajarito Acres) showed no radionuclide levels of concern. We are currently reanalyzing a sample from the same Los Alamos townsite hive collected during the same period of time, and the results will appear in the next report.

d. Long-Term Trends. Several recent long-term data evaluations have examined radionuclide concentrations, particularly tritium, in bees and honey within the LANL environs. The first study evaluated a host of radionuclides (tritium; cobalt-57; cobalt-60; europium-152; potassium-40; beryllium-7; sodium-22; manganese-54; rubidium-83; cesium-137; plutonium-238 and plutonium-239, -240; strontium-90; americium-241; and uranium) in honey collected from hives located around the perimeter of LANL (Los Alamos and White Rock/Pajarito Acres) over a 17-year period (Fresquez et al., 1997a). All radionuclides, with the exception of tritium, in honey collected from perimeter hives around LANL were not significantly different ($p<0.05$) from background. Overall, the maximum total net positive CEDE—based on the average concentration plus two standard deviations of all the radionuclides measured over the years after the subtraction of background—from consuming 11 lb of honey (maximum consumption rate) collected from Los Alamos and White Rock/Pajarito Acres was 0.031 mrem/yr and 0.006 mrem/yr, respectively. The highest CEDE was <0.04% of the International Commission on Radiological Protection permissible dose limit of 100 mrem/y from all pathways.

The second study examined tritium concentrations in bees and honey collected from within and around LANL over an 18-year period (Fresquez et al., 1997b). Based on the long-term average, bees from nine out of eleven hives and honey from six out of eleven hives on LANL lands contained tritium that was significantly higher ($p<0.05$) than background. The bees with the highest average concentration of tritium (435 pCi/mL) collected over the years were from LANL's TA-54—a low-level radioactive waste disposal site (Area G). Similarly, the honey with the highest average concentration of tritium (709 pCi/mL) was collected from a hive located near three tritium-contaminated storage ponds at LANL TA-53. The average concentrations of tritium in bees and honey from background hives were 1.0 pCi/mL and 1.5 pCi/mL, respectively. Although the concentrations of tritium in bees and honey from most LANL and perimeter (White Rock/Pajarito Acres) areas were significantly higher than background, most areas, with the exception of TA-53 and TA-54, generally exhibited decreasing tritium concentrations over time.

C. Biota Monitoring

1. Introduction

In addition to the biota associated with human foodstuffs, DOE Orders 5400.1 and 5400.5 mandate the monitoring of nonfoodstuff biota for the protection of ecosystems (DOE 1991). Nonfood biota, such as small mammals, amphibians, birds, and vegetation, will be monitored within and around LANL on a systematic basis for radiological and nonradiological constituents. Organic compound analysis, however, will dominate the bulk of the analysis, because it has been determined that the highest risk to nonhuman biota (i.e., animals) at the Laboratory is generally not from radionuclides but rather from organic compounds such as pesticides and polychlorinated biphenyls (PCBs) (Gonzales 1999).

This year, we report on vegetation collected within and around LANL. Vegetation is the foundation of ecosystems because it provides a usable form of energy and nutrients that are transferred through food chains. Because of this function in the food chain, vegetation can serve as a pathway to biological systems. Plants contain radionuclides that settle from "global fallout" (foliar deposition) after resuspension with soil and that are absorbed by plant roots, which occurs on a limited basis (Whicker and Shultz 1982). Consequently, monitoring radionuclide concentrations in vegetation over time is important to understanding the nature of radionuclide transport via food chains and to understanding the dynamics of radioactivity in the environment at nuclear facilities. Knowledge of contaminant levels in vegetation also serves as a "baseline" that becomes important for comparison to post-episodic events or accidents like wildfire that potentially change the baseline condition.

This section will also report work associated with ecological risk assessment at LANL. Ecorisk is becoming an important issue at LANL and other DOE sites; such information is important in establishing site-specific coefficients of contaminant transfer between different feeding levels so that accurate radiation dose estimates can be made (Whicker and Schultz 1982; Calabrese and Baldwin 1993; EPA 1998).

The two main objectives of the biota program are (1) to determine contaminant concentrations in biota at on-site LANL and perimeter areas and compare them with off-site regional background areas and (2) to determine trends over time.

2. Alfalfa Forage

a. Monitoring Network. We collected alfalfa plants—forage that is typically fed to domestic animals—from perimeter and regional background locations (Figure 6-2). Perimeter areas included the Los Alamos townsite, White Rock/Pajarito Acres townsite, and San Ildefonso Pueblo. Alfalfa (unwashed) from areas around the perimeter of LANL was compared with alfalfa collected from regional background fields in northern New Mexico; these fields are located in the Española, Santa Fe, and Jemez areas. The regional sampling locations are far enough from the Laboratory that they are unaffected by Laboratory airborne emissions.

b. Sampling Procedures, Data Management, and Quality Assurance. All QA/QC protocols, chemical analyses, data handling, validation, and tabulation can be found in the ESH-20 OP entitled, "Produce Sampling and Processing for the Foodstuffs Monitoring Program," LANL-ESH-20-SF-OP-001, R0, 1997.

c. Radiochemical Analytical Results. Table 6-22 shows the concentrations of radionuclides in alfalfa forage collected from perimeter and regional background locations during the 1999 growing season. All radionuclide concentrations in alfalfa forage collected from perimeter areas were very low, and most were nondetectable and/or within RSRLs. Only one element, strontium-90, in alfalfa forage from San Ildefonso Pueblo was detected at above upper-level background concentrations. The difference between strontium-90 in alfalfa from San Ildefonso Pueblo and background, however, was low (1.5 pCi/g ash).

d. Nonradiochemical Analytical Results. Most concentrations of trace elements in alfalfa forage collected from perimeter and regional background locations during the 1999 growing season were below the LOD (Table 6-23). Only barium appeared to be higher in alfalfa collected from all of the perimeter areas compared with background. The differences in barium concentrations between perimeter sites and background, however, were low.

3. Native Vegetation

a. Monitoring Network. We collected vegetative overstory (trees) and understory (grass) samples from relatively level, open, and undisturbed areas at the same locations that soil surface samples have been collected over the years: regional background locations (three sites), LANL's perimeter (10 sites), and at LANL (12 sites) (see Figure 6-1). Areas sampled at LANL are not from SWMUs. Instead, the majority of on-site vegetation sampling stations are located on the mesa tops close to and downwind from major facilities and/or operations at LANL in an effort to assess the impact of transport or migration of contaminants on radionuclide levels in vegetation. This sampling focuses on vegetation that may have been contaminated by air stack emissions, fugitive dust (caused by the resuspension of dust from SWMUs and active firing sites), or other transport or migration (such as hydrological) followed by plant uptake. In 1999, the focus was on radionuclides and radioactivity, leaving metal and organic contamination considerations for another year.

The ten perimeter stations are located within 4 km (2.5 mi) of the Laboratory. These stations reflect the soil conditions of the inhabited areas to the north (Los Alamos townsite area—four stations) and east (White Rock area and San Ildefonso Pueblo lands—four stations) of the Laboratory. The other two stations, one located on US Forest Service land to the west and the other located on US Park Service land (Bandelier) to the southwest, provide additional coverage. We compared vegetation samples from all these areas with vegetation collected from regional background locations in northern New Mexico surrounding the Laboratory where radionuclides and radioactivity are from natural and/or worldwide fallout events. The background stations are located close to Embudo to the north, Cochiti Pueblo to the south, and Jemez Pueblo to the southwest. All are more than 32 km (20 mi) from the Laboratory and are beyond the range of potential influence from normal Laboratory operations (DOE 1991).

b. Sampling Procedures, Data Management, and Quality Assurance. Collection of samples for chemical analyses follows a set procedure to ensure consistent and accurate collection, processing, submittal, and posting of analytical results. Stations and samples have unique identifiers to provide chain-of-custody control from the time of collection through analysis and reporting. Overstory samples consisted of conifer (ponderosa pine, one-seed juniper, and piñon pine) tree-shoot tips approximately 2.5–5.0 cm (1 to 2 in.) in length at 1.3 to 1.6 m (4 to 5 ft) above soil level. Understory samples consisted of composited grass subsamples of various species collected from 10 × 10 m (32 × 32 ft) plots. Protocols for QA/QC, data handling, validation, and tabulation can be found in the ESH-20 OP entitled "Sampling and Processing Samples for the Waste-Site Monitoring Program," LANL-ESH-20-SF-OP-011, R0, 1997. Radionuclide analysis of unwashed samples generally consisted of alpha spectroscopy (plutonium-238, plutonium-239, and americium-241), gamma spectroscopy (cesium-137), and liquid scintillation (strontium-90 and tritium). The specific procedure can be found at *http://cst.lanl.gov/docs* or in hardcopy within the LANL document LA-10300-M, Vol. III, Method ANC325 – 331, R.0 (Gautier 1995).

c. Radiochemical Analytical Results. Tables 6-24 (understory) and Table 6-25 (overstory) show the measured and arithmetic mean concentrations for vegetation collected in 1999 at LANL, perimeter, and regional background stations. Nonparametric descriptive statistics and results of the Kendall's Tau tests generally indicate no difference in radionuclide concentrations between sites. The exceptions were statistically higher ($p<0.05$) concentrations of tritium in LANL (on-site) understory vegetation than in perimeter understory and in LANL overstory compared with background. The mean tritium concentration in LANL understory vegetation was 501 pCi/L compared with 144 pCi/L in perimeter understory; however, there was overlap between respective interquartiles. The mean tritium concentration in LANL overstory was 463 pCi/L compared with –63 pCi/L in background overstory with no overlap of interquartile ranges.

With generally no differences among the sites, the need to assess the influence of overstory species on radionuclide concentrations between sites (i.e., determine whether species effects confounded the influence of sample locations) is diminished. Nevertheless, this issue is of scientific interest; therefore, we combined data by overstory species across two sites, a LANL site and a perimeter site, and tested for significant differences. We detected no differences in radionuclide concentrations between piñon pine and ponderosa pine.

Maximum on-site understory radionuclide concentrations are as follows: total uranium was 0.0730 μg/g dry; strontium-90 was 0.243; cesium-137 was 0.131; plutonium-238 was 0.197; plutonium-239 was 0.00045; and americium-241 was 0.00056 pCi/g dry. These values are all lower than toxicity reference values that were assumed to represent "safe limits" that protect nonhuman biota. For a more complete description of results of this study, see Gonzales et al., (2000a).

4. Ecological Risk Assessment

a. Approach. Ecological risk assessment is the qualitative or quantitative appraisal of effects, potential or real, of stressors such as contamination on flora, fauna, and/or populations, communities, or ecosystems. The relationship between ecological risk assessment and environmental surveillance is severalfold. First, the Environmental Surveillance Program provides contaminant data for assessing potential effects on ecological entities, including flora, fauna, and/or populations, communities, or ecosystems. The data collected for surveillance programs include concentrations of contaminants in environmental abiotic and biotic media, both of which are useful in ecological risk assessments. The biocontaminant data can also validate ecological risk models by comparing the accuracy of model predictions with real data. Second, the results of ecological risk assessments can help identify gaps in the Environmental Surveillance

Program (Gonzales et al., 1998; Gonzales 1999). For example, ecological risk assessments on threatened and endangered (T&E) species at LANL established the need to develop an organic-contaminant focus area as a component of the LANL Environmental Surveillance Program. Another example is the need for knowledge of contaminant levels in amphibians native to the LANL environment and related potential risk.

The monitoring of organics in the Environmental Surveillance Program will undoubtedly help to focus additional ecological risk assessments. Thus, the relationship between Environmental Surveillance Program and ecological risk assessment is mutualistic and iterative. As does the Environmental Surveillance Program, ecological risk assessments also help identify special studies that enhance the basis on which environmental compliance is founded. For example, Ferenbaugh et al. (1999) studied the potential effects of radionuclides on deer and elk that forage around the perimeter of Area G at LANL and measured radionuclide concentrations in deer and elk muscle tissue. The results of this study validated dose modeling in accord with predictions of uptake using equations in NCRP Report 76 (NCRP 1984).

b. History. The Laboratory is in the early stages of an ecological risk assessment program. This void is due in part to the infancy of this field worldwide and/or to emphasis on related pieces or components of ecological risk assessment such as monitoring and modeling of contaminant release, fate, and transport. In 1996, the Environmental Impact Statement Record of Decision on the Dual Axis Radiographic Hydrodynamic Test facility (DARHT) at LANL specified, among other things, the requirement for closer observance of the federal Endangered Species Act of 1973. As a result of this requirement, between 1996 and 1999, we completed risk assessments on four T&E species and initiated at least two related field studies. Previous Environmental Surveillance Reports have contained summaries of the T&E assessments. In late 1999, a similar approach was begun for application to non-T&E species, and summaries of these results will appear in future Environmental Surveillance Reports.

c. Results. The 1998 Environmental Surveillance Report contained a summary of the assessment of the last of four T&E species (southwestern willow flycatcher). In 1999, we documented the FORTRAN computer model ECORSK.5. A summary of the ECORSK.5 documentation appears later in the Special Studies section of Chapter 6.

D. Other Environmental Surveillance Program Activities and Special Studies around Los Alamos National Laboratory

1. MDA G, TA-54, Environmental Surveillance and Studies

a. “Radionuclide Concentrations in Soils and Vegetation at Low-Level Radioactive Waste Disposal Area G During the 1998 Growing Season (with a cumulative summary of tritium and plutonium-239 over time).” Soils and unwashed overstory and understory vegetation were collected at eight locations within and around MDA G, a disposal facility for low-level radioactive solid waste at the Laboratory. We analyzed the samples for tritium, plutonium-238, plutonium-239, strontium-90, americium-241, cesium-137, and total uranium. Most of the radionuclide concentrations in soils and vegetation were within the upper 95% level of background concentrations except for tritium and plutonium-239. Tritium concentrations in vegetation from most sites were greater than background concentrations of about 2 pCi/mL. The concentrations of plutonium-239 in soils and understory vegetation were largest in samples collected several meters north of the transuranic waste pad area and were consistent with previous results. Based on tritium and plutonium-239 data through 1998, we saw that (1) concentrations were significantly greater than background concentrations ($p<0.05$) in soils and vegetation collected from most locations at MDA G, and (2) the data showed no systematic increase or decrease in concentrations with time (Fresquez et al., 1999b).

b. “Sampling of Perimeter Surface Soils at Technical Area 54, MDA G.” During fiscal year (FY) 1998, 39 surface soil samples were collected from the perimeter of MDA G, TA-54. The locations we sampled depended on historical data collected at MDA G between 1993 and 1997. We chose the locations for the FY98 surface soil samples to best indicate whether contaminants, under the influence of surface water runoff, were moving outside the MDA G, TA-54, perimeter. Each sampling point was located in small but obvious drainage channels just outside the perimeter fence. These sampling locations thus offered the best opportunity to determine whether contaminated soil was being carried by surface water runoff from within the confines of MDA G to beyond the MDA G fence. The radioactive constituents measured in these surface soil samples included americium-214, cesium-137, isotopic plutonium, and tritium.

The analytical results of the surface soil sampling indicate that some perimeter soils at MDA G continue to be elevated above background levels for tritium and plutonium. The most elevated concentrations of tritium in soils are prevalent in locations that are adjacent to the active tritium disposal shafts and next to a series of inactive tritium shafts and the transuranic waste storage pads. Isotopic plutonium and americium-241 are slightly elevated in perimeter surface soils located adjacent to the transuranic pads. Cesium-137 is uniformly distributed in the perimeter soils. The perimeter soil samples were not analyzed for total uranium, but previous years' uranium data have shown a uniform distribution in surface soils with no evidence of elevated levels over background. We observed no gross changes in radioactivity in surface soil samples, and the samples collected in FY98 contain radioactivity similar to samples collected in previous years. Our sampling did not define any new locations where surface soils were elevated with radioactivity. These findings are consistent with analogous measurements taken in FY93 through FY97. The MDA G perimeter surface soil data indicate that very little radioactivity moves outside of MDA G under the influence of surface water runoff (Childs 1999).

c. "Radionuclide in Honey Bees from Area at TA-54 during 1998." We collected honey bees from two colonies located at the Laboratory's MDA G, TA-54, and from one control (background) colony located near Jemez Springs, NM. Samples were analyzed for various radionuclides. MDA G sample results from both colonies were higher than the upper (95%) level background concentration for plutonium-239, tritium, and total uranium. Sample results from one colony were higher than the upper (95%) level background concentration for plutonium-238 (Haarmann and Fresquez, 1999).

d. "Elk and Deer Study, Material Disposal Area, Technical Area 54." MDA G is the primary low-level radioactive waste disposal site at the Laboratory and occupies 26 ha on the eastern side of LANL adjacent to San Ildefonso Pueblo lands. Analyses of soil and vegetation collected from the perimeter of MDA G show concentrations of radionuclides greater than background concentrations established for northern New Mexico. As a result, pueblo residents have become concerned that contaminants from MDA G could enter tribal lands through various pathways. The residents have specifically questioned the safety of consuming meat from elk and deer that forage near MDA G and then migrate on to tribal lands.

This study addresses the uptake of a host of radionuclides by elk (*Cervus elaphus*) and deer (*Odocoileus hemionus*) that forage around the perimeter of MDA G, the health risks to the animals from this uptake, and the health risks to humans that consume meat from these elk and deer. Uptake by and internal dose to animals were estimated using equations from the National Council on Radiation Protection and Measurements Report 76 coded into a Microsoft Excel spreadsheet. The RESRAD computer code estimated the external dose to animals and the dose to humans consuming elk or deer meat. Soil and water concentrations from the perimeter of MDA G and from background regions in northern New Mexico were averaged over four years (1993–1996) and used as input data for the models. Concentration estimates the spreadsheet model generated correspond to the concentration range measured in actual tissue samples taken from elk and deer collected as part of the Environmental Surveillance Program at LANL. The highest dose estimates for both animals (17 mrad/yr) and humans (0.072 mrem/yr) were well below guidelines established to protect the environment (100 mrad/day) and the public (100 mrem/yr) from radiological health risks (Ferenbaugh et al., 1998; Ferenbaugh et al., 1999).

e. "The Relationship Between Pocket Gophers (*Thomomys bottae*) and the Distribution of Buried Radioactive Waste at the Los Alamos National Laboratory." MDA G at the Laboratory is a low-level radioactive waste storage facility. The noticeable presence of pocket gopher mounds and cast soil on closed waste burial sites of various types resulted in the need to understand possible interactions between gophers and radioactive waste at MDA G. In our study, we collected pocket gophers, mound soil, off-mound surface soil, and vegetation at MDA G and at off-site background locations. The samples were analyzed for four radionuclides (americium-241, plutonium-238, plutonium-239, and tritium) and total uranium.

A comparison of radionuclide concentrations in mound soil with surface soil and in gophers with soil and vegetation suggests that gopher activity is generally not resulting in the upward transport of radionuclides. Concentrations of americium-241, plutonium-238, plutonium-239, and tritium in some of the gopher, soil, and vegetation samples were higher than background at some of the sites. Gophers at one site within MDA G had tritium concentrations that resulted in an estimated dose that could impact the gophers' health. We conducted correlation tests to examine relationships in radionuclide concentrations among the four media (pocket gophers, mound soil, off-mound surface soil, and vegetation). Correlations were highest for americium-241 and plutonium-238; however, only the plutonium-238 relationship may be accurate enough for use in predicting concentrations. Data this study generated are valuable for ecological risk assessments. Further investigation through modeling and monitoring may be necessary to determine if the tritium shafts are a source of environmental tritium levels that are of ecological concern. Future research should include modeling the transport of radionuclides through ecological receptors within and around MDA G. This modeling should investigate transfer to high-level carnivores, especially raptors (Gonzales et al., 2000b).

2. DARHT, TA-15, Environmental Surveillance Programs

a. "Baseline Concentrations of Radionuclides and Trace Elements in Soils and Vegetation Around the DARHT Facility: Construction Phase (1998)." The Mitigation Action Plan for the DARHT facility at the Laboratory mandates the establishment of baseline concentrations for potential environmental contaminants. To this end, we determined concentrations of tritium, cesium-137, strontium-90, plutonium-238, plutonium-239, americium-241, and total uranium and silver, arsenic, barium, beryllium, cadmium, chromium, copper, mercury, nickel, lead, antimony, selenium, and thallium in surface and subsurface soils, sediments, and vegetation (overstory and understory) around the DARHT facility during the construction phase in 1998 (this is the third year of a four-year baseline study). We also measured volatile and semivolatile organic compounds in soils and sediments.

In 1999, most radionuclides and trace metals in soil, sediment, and vegetation were similar to past years at DARHT and were within regional background concentrations. Exceptions were concentrations of strontium-90, beryllium, barium, and total uranium in some samples; these concentrations exceeded upper-limit regional background concentrations (i.e., they exceeded the mean plus two standard deviations). We detected no volatile organic compounds and very few semivolatile organic compounds in soils and sediments at DARHT. We summarized mean ($\pm$ std dev) radionuclide and trace element concentrations measured in soil, sediment, and vegetation over a three-year period (construction phase) (Fresquez et al., 1999a).

b. "Concentrations of Radionuclides and Heavy Metals in Honey Bee Samples Collected Near DARHT and a Control Site (1998)." We collected honey bees from two colonies located at the Laboratory's DARHT facility and from one control (background) colony located near Jemez Springs, NM. Samples were analyzed for various radionuclides and heavy metals. DARHT facility sample results from both colonies were higher than the upper (95%) level background concentration for cesium-137, thalium-208, total uranium, and barium. Sample results from one colony were higher than the upper (95%) level background concentration for manganese-54, plutonium-239, and copper (Haarmann 1999).

3. Ecological Risk Assessment Studies

"Documentation of the Ecological Risk Assessment Computer Model ECORSK.5." This study summarizes the documentation of ECORSK.5, an ecological risk computer model used to estimate the potential toxicity of radioactive and nonradioactive contaminants to several T&E species at the Laboratory. These analyses to date include preliminary toxicity estimates for the Mexican spotted owl, the American peregrine falcon, the bald eagle, and the southwestern willow flycatcher. The Record of Decision for the construction of the DARHT facility at LANL required this work as part of the Environmental Impact Statement. The model is dependent on the use of the geographic information system and associated software—ARC/INFO—and has been used in conjunction with LANL's Facility for Information Management and Display (FIMAD) contaminant database. The integration of FIMAD data and ARC/INFO using ECORSK.5 allowed the generation of spatial information from a gridded area of potential exposure called an Ecological Exposure Unit. ECORSK.5 simulated exposures using a modified Environmental Protection Agency Quotient Method. The model can handle a large number of contaminants within the home range of species. This integration results in the production of hazard indices which, when compared with risk evaluation criteria, estimate the potential for impact from the consumption of contaminated food and ingestion of soil.The full report (Gallegos and Gonzales, 1999) summarizes and documents the ECORSK.5 code, the mathematical models used to develop ECORSK.5, and the input and other requirements for its operation. Other auxiliary FORTRAN77 codes that process and graph output from ECORSK.5 are also discussed. The reader may refer to other LANL reports to obtain greater detail on past applications of ECORSK.5 and assumptions used in deriving model parameters. A FORTRAN90 version of the code is under development.

4. Fire Ecology Studies

a. "Fuels Inventories and Spatial Modeling of Fire Hazards in the Los Alamos Region." Several land management agencies, including Los Alamos National Laboratory, Los Alamos County, Santa Fe National Forest, and Bandelier National Monument, are working collaboratively toward reducing the fire hazard in the Los Alamos wildland-urban interface. As part of this multiyear project, we have been inventorying fuels, determining the spatial patterns of the fuel levels, assessing the values at risk in the wildland-urban interface, and designing optimal mitigation action strategies. Here we review the preliminary results of the initial two years of fuels inventories and related analyses. The first year, 1997, we conducted a preliminary survey of fuel levels along the elevation gradient from piñon-juniper woodlands to ponderosa pine forests and mixed conifer forests and on selected topographic positions: canyons, mesas, and mountains. The surface fuels were greatest in mixed conifer forests, whereas the overstory fuels were greatest in mixed conifer forests and in ponderosa pine forests on mesas. These results provided direction for the surveys conducted during the second year, 1998. We selected a random sample of sites above 2100 m to emphasize the portion of the study region that supported the highest fuel loads. During 1998, we found that the surface fuels and overstory fuels are greatest at higher elevations in the study region and on north-facing aspects or on relatively steep slopes. Conversely, the variability among the overstory fuels is the greatest at lower elevations in the ponderosa pine zone.

The results of this preliminary survey have several consequences. First, the surveyed fuel loads are consistent with predicted and actual patterns of fire behavior in the study region. Second, the highly variable fuels at lower elevations present a dilemma to land managers who wish to protect federal facilities and residential areas in the wildland-urban interface. Third, these results are useful for mapping the fuel loads in the Los Alamos wildland-urban interface. Fourth, the data this project generated are serving as inputs to predictive wildfire behavior models and as the basis for optimal mitigation action strategies (Balice et al., 1999).

b. "Mapping Fuel Risk at the Los Alamos Urban-Wildland Interface." Remote sensing and geographic information system (GIS) technologies support the goals of Los Alamos to use current technology in expanding information to reduce fire hazard within its wildland-urban interface. The forests and woodlands on the east slopes of the Jemez Mountains are generally overstocked and have the potential to produce intense wildfires that could threaten lives, property, and natural resources. Overall overstory fuel classification accuracy was 96.10 %, with a kappa coefficient of 0.95. Average modeled understory fuel loads increase from 4.89 tons/acre in grass, to 28.29 tons/acre in ponderosa pine, 31.53 tons/acre in aspen, and 52.05 tons/acre in mixed conifer. The coefficient of variation, which measures the reliability of the means, is almost the same for the mixed conifer and ponderosa pine data, at around 0.34 (Yool et al., 2000).

5. Aquatic Studies

a. "Radionuclides and Trace Elements in Fish Upstream and Downstream of Los Alamos National Laboratory and the Doses to Humans from the Consumption of Muscle and Bone." The purpose of this study was to determine radionuclide and trace element concentrations in bottom-feeding fish (catfish, carp, and suckers) collected from the confluences of some of the major canyons that cross Laboratory lands with the Rio Grande and the potential radiological doses from the ingestion of these fish. We analyzed samples of muscle and bone (and viscera in some cases) for tritium; strontium-90; cesium-137; total uranium; plutonium-238 and plutonium-239, 240; and americium-241 and silver, arsenic, barium, beryllium, chromium, cadmium, copper, mercury, nickel, lead, antimony, selenium, and thallium. Most radionuclides, with the exception of strontium-90, in the muscle plus bone portions of fish collected from LANL canyons/Rio Grande were not significantly ($p<0.05$) higher than those from fish collected upstream (San Ildefonso/background) of LANL. Strontium-90 in fish muscle plus bone tissue significantly ($p<0.05$) increases in concentration starting from Los Alamos Canyon, the most upstream confluence (fish contained 3.4E-02 pCi/g), to Frijoles Canyon, the most downstream confluence (fish contained 14E-02 pCi/g). The differences in strontium-90 concentrations in fish collected downstream and upstream (background) of LANL, however, were very small.

Based on the average concentrations (±2SD) of radionuclides in fish tissue from the four LANL confluences, the committed effective dose equivalent from the ingestion of 46 lb (maximum ingestion rate per person per year) of fish muscle plus bone, after the subtraction of background, was 0.1 ± 0.1 mrem/yr and was far below the International Commission on Radiological Protection (all pathway) permissible dose limit of 100 mrem/yr. Of the trace elements that were found above the limits of detection (barium, copper, and mercury) in fish muscle collected from the confluences of canyons that cross LANL and the Rio Grande, none were in significantly higher ($p<0.05$) concentrations than in muscle of fish collected from background locations (Fresquez et al., 1999c).

b. "Organic Contaminant Levels in Three Fish Species Down Channel from the Los Alamos National Laboratory." We analyzed three species of fish from sites upriver and downriver of the LANL in the Rio Grande for pesticides and PCBs. Data were used to implicate potential sources of the contaminants and to discuss potential risk to fish, the bald eagle, and humans. Eight of 28 contaminants were measurable in at least one sample of fish muscle tissue. Of 18 samples total, there were 18 detections of dichlorodiphenylethylene (DDE), eight of Aroclor-1254, five of dichloroethane, two of dichlorodiphenyltrichloroethane (DDT), two of endosulfan sulfate, two of gamma-chlordane, and one of Aroclor-1260. The Laboratory contribution, if any, to pesticide levels in the common carp (*Carpiodes carpio*), the channel catfish (*Ictalurus punctatus*), and the white sucker (*Catostomus commersoni*) in the Rio Grande appears to be small. The source of the DDT-related compounds was probably a pest control event in 1963 in which approximately 500,000 acres of forest west of the Rio Grande in the Santa Fe and Carson National Forests were sprayed with approximately one pound per acre of DDT (~141,000 ppm–weight/weight). DDE concentration among fish species was significantly different: the white sucker had significantly lower levels of 4,4' – DDE than the common carp and the channel catfish. This difference may have affected location treatment means of 4,4' – DDE because equal numbers of each species at each sampling site were not used; therefore, studies that attempt to discern effects related to location should consider species, feeding habits, and other factors.

Maximum DDE concentrations in all three fish species (0.03 to 0.15 mg/kg) were slightly below the minimum range in concentration (0.2 to 1.0 mg/kg) that has been associated with reproductive effects of sensitive bird species.

Assuming a maximum total fish ingestion of 21 kg/yr and a 70-kg human consumer body weight, the maximum DDT consumption by humans would be 6.7×10^{-5} mg/kg/d, which is lower than the EPA human risk value of 5×10^{-4} mg/kg/d. The mean total DDT concentration of 82 µg/kg results in an EPA recommendation of no consumption restrictions for chronic systemic health endpoints for the general human population. At the largest meal size and most protective criteria, the EPA recommends minor consumption restrictions for chronic systemic health endpoints for children and for carcinogenic health endpoints for the general population.

Maximum Aroclor-1254 concentrations in all three fish species (0.05 to 0.66 mg/kg) were well below the minimum range in concentration (50 to 100 mg/kg) that may adversely affect growth and reproduction of fish. Assuming a maximum total fish ingestion of 21 kg/yr and a 70-kg consumer body weight, the maximum Aroclor-1254 consumption would be 1.1×10^{-4} mg/kg/d. This level is above the EPA human risk value of 2×10^{-5} mg/kg/d. Regarding the mean Aroclor-1254 concentration in fish, 0.13 mg/kg, the EPA recommends minor consumption restrictions on the basis of chronic systemic health endpoints for the general population and on developmental health endpoints for women of reproductive age (Gonzales et al., 1999).

c. "Effects of Depleted Uranium on the Survival and Reproduction of *Ceriodaphnia dubia*." Depleted uranium (DU) released to the environment during military weapons testing is generally alloyed with other heavy metals (e.g. beryllium, cadmium, lead) and found in the soil of impact test fields as three uranium oxides. The low solubility of the alloyed heavy metals and the uranium oxides has led researchers to consider DU in the soil as more of a terrestrial hazard than an aquatic one. However, research has indicated DU present in soil is not stationary and has the potential to move into aquatic systems. The primary focus of previous research on terrestrial systems has left an information gap in the chemical and biological effects of DU on aquatic organisms. This study addressed the effects of DU-contaminated soil on the health of the water flea (*Ceriodaphnia dubia)*. We conducted a 96-hour acute assay and a seven-day chronic assay to measure the contaminant effect on survival and reproduction of *Ceriodaphnia dubia* exposed to dilutions of test water overlying and aged with DU soil and a reference soil (relatively contaminant free). Statistical analysis indicated a significant difference in survival and reproduction in test dilutions (12.5% and 50%) compared with control (0.0) and reference groups. We analyzed test water collected from treatment, control, and reference samples throughout the acute and chronic assays by mass spectrophotometry to identify the concentrations of uranium-238, uranium-235, beryllium, cadmium, and lead. Information this study generated will enable researchers to determine the potential impact of long-term sublethal concentrations of DU on aquatic systems (Kuhne et al., 1999).

6. Elk Studies

"Resource Use, Activity Patterns, and Disease Analysis of Rocky Mountain Elk (*Cervus elaphus nelsoni*) at the Los Alamos National Laboratory." To form the basis for developing management strategies for elk and other large herbivores, it is necessary to understand how, when, where, and why animals move with respect to the landscape and availability of essential habitats for foraging and watering. From 1996 to 1998, we evaluated daily/seasonal movements, habitat use, and activity patterns of elk on and near Laboratory property through the use of global positioning system collars and the Geographic Information System. We have identified primary travel corridors on and immediately adjacent to LANL property and identified travel routes for collared animals moving west off LANL property in the vicinity of Pajarito Mountain. Daily use of different land cover types and terrain was evaluated seasonally by comparing six four-hour periods to one another: 0000–0400, 0400–0800, 0800–1200, 1200–1600, 1600–2000, and 2000–2400.

Significantly more locational fixes of elk took place in piñon/juniper cover (Pearson's x test, $p<0.05$) compared with all other cover types between the hours of 0400–1200 and significantly more than all other cover types, except ponderosa pine, through the 2000 hour period. In general, use of piñon/juniper increased during daylight hours and decreased during evening hours. Use of grasslands decreased during day hours while increasing during evening hours. Generally, the elk used northeast slopes more than expected and west and northwest slopes less than expected. We found significantly greater fixes on 0°–5° slopes compared to all other slope classes between the evening and early morning hours of 1600–0400 and significantly greater than slopes above 10° for all hourly subperiods except 0800–1200. During spring, use of 0°–5° slopes decreased during midday and increased during evening and early morning hours, and animals tended to increase their proportion of use on steeper slopes in most subperiods during summer. We also examined diseases of animals by analyzing blood samples drawn from all collared elk. Vesicular stomatitis was the most commonly observed disease among tested elk. By understanding movement and activity patterns of elk on LANL property, management strategies can be developed and applied to reduce adverse impacts, such as automobile accidents and overuse of sensitive habitats associated with this species (Biggs et al., 1998).

7. Small Mammal Studies

a. "Development and Application of a Habitat Suitability Ranking Model for the New Mexico Meadow Jumping Mouse (*Zapus hudsonius luteus*)." The New Mexico meadow jumping mouse (*Zapus hudsonius luteus*) is currently listed as a state threatened species in New Mexico and has been identified as potentially occurring within the Laboratory boundary. We describe the development of a model to identify and rank habitat at LANL that may be suitable for occupation by this species. The model calculates a habitat suitability ranking (HSR) based on total plant cover, plant species composition, total number of plant species, and plant height. Input data for the model are based on the measurement of these variables at locations where this species has been found within the Jemez Mountains. Model development included selecting habitat variables (HV), developing a probability distribution for each variable, and applying weights to each variable based on their overall importance in defining the suitability of the habitat.

The HVs include plant cover (HV1), grass/forb cover (HV2), plant height (HV3), number of forbs (HV4), number of grasses (HV5), and sedge/rush cover (HV6). Once we selected the HVs, we calculated probability values for each. Each variable was then assigned a "weighting factor" to reflect the variables' importance relative to one another with respect to contribution to quality of habitat. The least important variable, sedge/rush cover, received a weight factor of "1," with increasing values assigned to each remaining variable as follows: number of forbs = 3, number of grasses = 3, plant height = 5, grass/

forb cover = 6, and total plant cover = 7. Based on the probability values and weighting factors, a HSR is calculated as follows: HSR = (PHV1(7) + PHV2(6) + PHV3(5) + PHV4(3) + PHV5(3) + PHV6(1)). Once calculated, the HSR values are placed into one of four habitat categorical groupings by which management strategies are applied (Biggs et al., 1999).

b. "Evaluation of PCB Concentrations in Archived Small Mammal Samples from Sandia Canyon." During the summer of 1996, concerns developed about PCBs within the Laboratory's Sandia Canyon. We submitted archived small mammal samples (voles, *Microtus* spp.; harvest mouse, *Reithrodontomys megalotis*; vagrant shrews, *Sorex vagrans*; and deer mouse, *Peromyscus maniculatus*) comprising adipose tissue and internal organs from 1995 (thirty samples) and 1996 (thirty-four samples) to determine PCB levels. During the summer of 1998, we selected a reference site in South Fork Canyon of the Jemez Mountains and collected thirty samples of small mammal adipose tissue and internal organs from this site to be analyzed for PCBs. Nine samples from 1995 and 19 samples from 1996 had detectable or estimated concentrations of PCBs, whereas no samples from the reference site (background) had detectable PCB levels. PCB concentrations ranged from 49 to 19,000 mg/kg in the samples collected from Sandia Canyon. Preliminary evaluation of the data indicates that maximum levels of Arochlor-1260 approach minimum levels for which effects have been noted (Bennett et al., 1999).

8. Other Studies

a. "Moisture Conversion Ratios for the Foodstuffs and Biota Environmental Surveillance Programs at Los Alamos National Laboratory: 1999 (Revision 1)." This paper reports the mean ash to dry weight and dry to wet weight moisture ratios for a variety of foodstuffs and biota commonly collected as part of the Environmental Surveillance Programs at the Laboratory (Fresquez and Ferenbaugh, 1999).

b. "Amphibians and Reptiles of Los Alamos County." Recent studies have shown that amphibians and reptiles are good indicators of environmental health. They live in terrestrial and aquatic environments and are often the first animals affected by environmental change. This publication provides baseline information about amphibians and reptiles on the Pajarito Plateau. The report contains ten years of data collection and observations by researchers at the Laboratory, the University of New Mexico, the New Mexico Department of Game and Fish, and hobbyists (Foxx et. al, 1999).

c. "Quantitative Habitat Evaluation of the Conveyance and Transfer Project." The transfer of federally controlled, ecologically sensitive land has become the focus of recent controversy. It has become increasingly important to assess quantitatively the potential impacts of transferring such lands and the associated natural resources. As part of natural resources planning for the Conveyance and Transfer (C&T) Project, we conducted a quantitative field evaluation to assess and rank various habitats in or near the proposed transfer tracts. Field data were collected and analyzed. These data were coupled with an integrated Geographical Information System spatial analysis to assign an overall habitat ranking to both Rendija and Pueblo Canyons. We also ranked plots within the transfer tracts. The results of this study indicate that the overall habitat rankings of the proposed C&T tracts do not differ from the habitat ranking of the canyons in which they are located. Therefore, it is likely that the transfer of these tracts would not result in a decrease in the overall habitat rankings of the canyons. This quantitative habitat evaluation process successfully addressed potential impacts of transferring these tracts (Haarmann and Haagenstad 1999).

Table 6-1. Radionuclides in Surface Soils Collected from Regional Background, Perimeter, and On-Site Locations during 1999

Location	^{3}H (pCi/mL)	^{90}Sr (pCi/g dry)	^{137}Cs (pCi/g dry)	^{tot}U (µg/g dry)	^{238}Pu (pCi/g dry)	^{239,240}Pu (pCi/g dry)	^{241}Am (pCi/g dry)	Gross Alpha (pCi/g dry)	Gross Beta (pCi/g dry)	Gross Gamma (pCi/g dry)
Regional Background Stations:										
Embudo	0.21 (0.64)[a]	[g]	0.23 (0.06)	1.78 (0.18)	0.001 (0.001)	0.012 (0.002)	0.011 (0.003)	3.1 (0.6)	2.8 (0.3)	2.1 (0.2)
Cochiti	0.27 (0.64)	[g]	0.24 (0.07)	1.81 (0.18)	0.000 (0.000)	0.008 (0.002)	0.013 (0.003)	3.6 (0.7)	2.7 (0.3)	2.2 (0.2)
Jemez	0.27 (0.64)	[g]	0.38 (0.08)	3.23 (0.32)	0.004 (0.001)	0.010 (0.002)	0.010 (0.002)	9.3 (2.1)	8.0 (1.3)	2.9 (0.3)
Mean (std dev)	0.25 (0.03)A[b]	0.30 (0.07)[h]	0.28 (0.08)A	2.27 (0.83)B	0.002 (0.002)B	0.010 (0.002)B	0.011 (0.002)A	5.3 (3.4)A	4.5 (3.0)A	2.4 (0.4)B
RSRL[c]	0.61	0.71	0.51	3.30	0.008	0.019	0.013	8.4	7.2	4.1
SAL[d]	1,900.00[e]	4.40	5.10	29.00	27.000	24.000	22.000	– – –	– – –	– – –
Perimeter Stations:										
Otowi	0.27 (0.64)	[g]	0.26 (0.15)	2.85 (0.29)	0.013 (0.003)	0.145 (0.009)	0.009 (0.003)	2.9 (0.6)	2.6 (0.2)	3.3 (0.3)
TA-8 (GT Site)	0.42 (0.65)	[g]	0.72 (0.14)	2.98 (0.30)	0.009 (0.002)	0.029 (0.003)	0.006 (0.002)	6.0 (1.2)	6.0 (0.4)	6.7 (0.7)
Near TA-49 (BNP)	0.24 (0.64)	[g]	0.82 (0.16)	3.73 (0.37)	0.001 (0.001)	0.024 (0.003)	0.010 (0.004)	6.1 (1.2)	5.4 (0.4)	6.7 (0.7)
East Airport	0.19 (0.64)	[g]	0.31 (0.08)	2.60 (0.26)	0.011 (0.003)	0.025 (0.004)	0.007 (0.002)	4.2 (0.8)	3.3 (0.3)	5.8 (0.6)
West Airport	0.34 (0.64)	[g]	0.24 (0.07)	2.74 (0.27)	0.010 (0.002)	0.047 (0.004)	0.009 (0.003)	5.1 (1.0)	5.0 (0.4)	5.4 (0.5)
North Mesa	0.32 (0.65)	[g]	0.31 (0.15)	2.98 (0.30)	–0.000 (0.001)[f]	0.012 (0.002)	0.003 (0.001)	5.4 (1.1)	4.1 (0.3)	2.8 (0.3)
Sportsman's Club	0.36 (0.65)	[g]	0.93 (0.18)	3.75 (0.38)	0.014 (0.002)	0.051 (0.004)	0.015 (0.003)	6.2 (1.2)	5.6 (0.4)	3.3 (0.3)
Tsankawi/PM-1	0.20 (0.64)	[g]	0.18 (0.08)	3.40 (0.34)	0.001 (0.001)	0.006 (0.001)	0.003 (0.001)	3.7 (0.7)	3.0 (0.3)	4.4 (0.4)
White Rock (East)	0.39 (0.65)	[g]	0.13 (0.06)	2.10 (0.21)	–0.000 (0.001)	0.003 (0.001)	0.001 (0.001)	5.2 (1.2)	4.0 (0.3)	3.0 (0.3)
San Ildefonso	0.43 (0.65)	[g]	0.63 (0.13)	2.15 (0.22)	0.010 (0.002)	0.044 (0.003)	0.009 (0.002)	4.9 (0.9)	3.8 (0.3)	3.0 (0.3)
Mean (std dev)	0.32 (0.09)A	0.34 (0.18)[h]	0.45 (0.29)A	2.93 (0.58)B	0.007 (0.006)A	0.039 (0.040)A	0.007 (0.004)A	5.0 (1.1)A	4.3 (1.2)A	4.4 (1.6)A
On-Site Stations:										
TA-16 (S-Site)	0.09 (0.64)	[g]	0.52 (0.11)	5.21 (0.52)	0.006 0.002	0.025 0.003	0.010 0.002	8.2 (1.6)	5.9 (0.4)	4.5 (0.4)
TA-21 (DP-Site)	0.26 (0.65)	[g]	0.11 (0.04)	2.61 (0.26)	0.004 0.002	0.045 0.005	0.008 0.003	4.8 (0.9)	2.5 (0.2)	2.7 (0.3)
Near TA-33	2.15 (0.77)	[g]	0.37 (0.08)	2.94 (0.29)	0.002 0.001	0.021 0.003	0.012 0.004	4.2 (0.8)	4.3 (0.3)	3.8 (0.4)
TA-50	0.06 (0.64)	[g]	0.72 (0.14)	9.06 (0.91)	0.010 0.002	[g]	0.060 0.013	7.5 (1.3)	5.7 (0.4)	4.0 (0.4)
TA-51	0.15 (0.64)	[g]	0.27 (0.07)	3.33 (0.33)	0.003 0.001	0.012 0.002	0.010 0.003	5.9 (1.1)	4.0 (0.3)	3.0 (0.3)
West of TA-53	0.45 (0.66)	[g]	0.27 (0.06)	3.69 (0.37)	0.003 0.001	0.021 0.002	0.009 0.003	5.4 (1.0)	3.5 (0.3)	2.6 (0.3)
East of TA-53	0.35 (0.66)	[g]	0.41 (0.10)	3.82 (0.38)	0.002 0.001	0.040 0.004	0.010 0.003	7.5 (1.4)	4.9 (0.4)	3.5 (0.3)
East of TA-54	0.72 (0.68)	[g]	0.41 (0.09)	3.04 (0.30)	0.021 0.005	0.054 0.004	0.020 0.004	3.7 (0.7)	2.4 (0.2)	3.3 (0.3)
Potrillo Drive/TA-36	0.16 (0.64)	[g]	0.22 (0.06)	3.18 (0.32)	0.001 0.001	0.009 0.002	0.004 0.001	4.9 (0.9)	3.0 (0.3)	2.8 (0.3)
Near Test Well DT-9	0.08 (0.64)	[g]	0.39 (0.09)	3.73 (0.37)	0.002 0.001	0.021 0.003	0.008 0.003	6.1 (1.1)	4.4 (0.3)	4.3 (0.4)
R-Site Road East	0.03 (0.63)	[g]	0.37 (0.08)	5.19 (0.52)	0.001 0.001	0.017 0.003	0.015 0.003	7.3 (1.4)	5.7 (0.4)	3.2 (0.3)
Two-Mile Mesa	0.20 (0.65)	[g]	0.24 (0.06)	3.59 (0.36)	0.000 0.001	0.010 0.002	0.006 0.002	5.3 (1.0)	3.2 (0.3)	2.7 (0.3)
Mean (std dev)	0.39 (0.59)A	0.42 (0.18)[h]	0.36 (0.16)A	4.12 (1.75)A	0.005 (0.006)B	0.025 (0.015)A	0.014 (0.015)A	5.9 (1.4)A	4.1 (1.2)A	3.4 (0.7)A

[a] (±1 counting uncertainty); values are the uncertainty of the analytical results at the 65% confidence level.
[b] Means within the same column followed by the same upper-case letter are not significantly different from one another using a Wilcoxon Rank Sum Test at the 0.05 probability level.
[c] Regional Statistical Reference Level; this is the upper (95%) limit background concentration (mean + 2 std dev) based on data from 1995 to 1999.
[d] Los Alamos National Laboratory Screening Action Level from Fresquez et al. (1996).
[e] Equivalent to the SAL of 260 pCi/g dry soil at 12% moisture.
[f] See Appendix B for an explanation of the presence of negative values.
[g] Sample lost in analysis, not analyzed, or outliers omitted.
[h] Average of 1993 to 1996 data (Fresquez et al., 1998).

Table 6-2. Strontium-90 (Positively Biased) Concentrations (pCi/g dry) in Surface Soils Collected from Regional Background, Perimeter, and On-Site Locations during 1999[a]

Location	LANL[a]		NMED[b]	
Regional Background Stations:				
Embudo	2.93	(0.44)[c]		
Cochiti	3.25	(0.45)		
Jemez	4.47	(0.52)		
Mean (std dev)	3.55	(0.81)B[d]		
Perimeter Stations:				
Otowi	4.55	(0.56)		
TA-8 (GT Site)	4.04	(0.53)		
Near TA-49 (BNP)	4.88	(0.61)	0.28	(0.21)
East Airport	3.92	(0.51)		
West Airport	3.79	(0.53)	0.03	(0.19)
North Mesa	5.07	(0.64)		
Sportsman's Club	4.94	(0.57)	0.24	(0.21)
Tsankawi/PM-1	5.20	(0.57)	–0.01	(0.22)
White Rock (East)	3.47	(0.50)		
San Ildefonso	4.70	(0.57)		
Mean (std dev)	4.46	(0.60)B	0.14	(0.15)A
On-Site Stations:				
TA-16 (S-Site)	5.24	(0.60)		
TA-21 (DP-Site)	4.95	(0.64)	0.04	(0.21)
Near TA-33	4.81	(0.60)	0.36	(0.20)
TA-50	5.27	(0.58)	0.40	(0.24)
TA-51	4.66	(0.55)		
West of TA-53	5.35	(0.67)		
East of TA-53	5.33	(0.60)	0.30	(0.20)
East of TA-54	4.47	(0.53)	0.20	(0.21)
Potrillo Drive/TA-36	4.54	(0.59)		
New Test Well DT-9	7.21	(0.68)		
R-Site Road East	5.42	(0.90)	0.27	(0.21)
Two Mile Mesa	4.45	(0.55)		
Mean (std dev)	5.14	(0.75)A	0.26	(0.13)A

[a]Positively biased data refer to LANL data that are considered invalid because of analytical laboratory problems; the data appear in this report for documentary purposes.
[b]NMED split sample data (Dave Englert, NMED, April 11, 2000).
[c](±1 counting uncertainty); values are the uncertainty of the analytical results at the 65% confidence level.
[d]Means within the same column followed by the same upper-case letter are not significantly different from one another using a Wilcoxon Rank Sum Test at the 0.05 probability level.

Table 6-3. Total Recoverable Light, Heavy, and Nonmetal Trace Elements (µg/g dry) in Surface Soils Collected from Regional Background, Perimeter, and On-Site Locations during 1999[a]

Location	Ag	As	Ba	Be	Cd	Cr	Hg	Ni	Pb	Sb	Se	Tl[c]
Regional Background Stations:												
Embudo	1.00[b]	1.00	[d]	0.62	0.20[b]	12.00	0.01[b]	6.40	11.90	0.10[b]	0.20[b]	0.10[b]
Cochiti	1.00[b]	3.00	[d]	0.75	0.20[b]	13.00	0.01[b]	6.80	9.20	0.10[b]	0.20[b]	0.10[b]
Jemez	1.00[b]	2.50	[d]	0.97	0.20[b]	19.00	0.01[b]	11.00	16.40	0.10[b]	0.40	0.10[b]
Mean	1.00A[c]	2.17A	[d]	0.78A	0.20A	14.67A	0.01A	8.06A	12.50B	0.10A	0.27A	0.10B
(std dev)	(0.00)	(1.04)		(0.18)	(0.00)	(3.78)	(0.00)	(2.55)	(3.64)	(0.00)	(0.12)	(0.00)
RSRL[e]	2.09	6.05	194.0	0.73	0.20	14.73	0.02	10.50	14.10	0.20	0.62	0.46
SAL[f]	400.00	6.00	5,600.0	0.90	80.00	400.00	24.00	1,600.00	500.00		400.00	
Perimeter Stations:												
Otowi	1.00[b]	0.70	[d]	0.30	0.20[b]	2.80	0.01	2.00[b]	8.00	0.25[b]	0.20[b]	0.25[b]
TA-8 (GT Site)	1.00[b]	1.20	[d]	0.87	0.20[b]	6.00	0.02	2.00[b]	22.80	0.01[b]	0.20[b]	0.10[b]
TA-49 (BNP)	1.00[b]	2.40	[d]	0.87	0.47	8.30	0.01	6.20	24.50	0.10[b]	0.20[b]	0.30
East Airport	1.00[b]	1.50	[d]	0.71	0.20[b]	7.20	0.01	4.40	18.30	0.10	0.20[b]	0.10[b]
West Airport	1.00[b]	2.70	[d]	1.20	0.20[b]	10.00	0.02	6.50	36.00	0.01[b]	0.20[b]	0.30
North Mesa	1.00[b]	2.70	[d]	1.00	0.20[b]	13.00	0.01	7.10	21.30	0.10[b]	0.20[b]	0.20
Sportsman's Club	1.00[b]	2.50	[d]	0.90	0.20[b]	9.40	0.01[b]	6.50	26.00	0.10[b]	0.20[b]	0.20
Tsankawi/PM-1	1.00[b]	0.70	[d]	0.86	0.20[b]	3.70	0.01	2.00[b]	14.00	0.10[b]	0.20[b]	0.10[b]
White Rock (East)	1.00[b]	2.20	[d]	1.10	0.20[b]	10.00	0.03	7.10	15.80	0.10[b]	0.20[b]	0.20
San Ildefonso	1.00[b]	2.00	[d]	0.63	0.20[b]	11.00	0.03	4.50	15.40	0.10[b]	0.20[b]	0.10[b]
Mean	1.00A	1.86A	[d]	0.84A	0.23A	8.14B	0.02A	4.83A	20.21A	0.10A	0.20A	0.19A
(std dev)	(0.00)	(0.78)		(0.25)	(0.09)	(3.23)	(0.01)	(2.16)	(7.77)	(0.07)	(0.00)	(0.08)
On-Site Stations:												
TA-16 (S-Site)	1.00[b]	2.20	[d]	1.10	0.20[b]	8.90	0.02	8.00	12.70	0.20[b]	0.20[b]	0.20[b]
TA-21 (DP-Site)	1.00[b]	2.70	[d]	0.83	0.20[b]	8.20	0.01	5.90	20.90	0.20[b]	0.20[b]	0.20[b]
Near TA-33	1.00[b]	1.50	[d]	0.71	0.20[b]	5.50	0.01[b]	4.60	13.00	0.20[b]	0.20[b]	0.20[b]
TA-50	1.00[b]	1.50	[d]	0.70	0.51	3.10	0.01	2.00[b]	10.30	0.20[b]	0.20[b]	0.20[b]
TA-51	1.00[b]	2.50	[d]	0.89	0.20[b]	8.20	0.01	6.00	14.40	0.20[b]	0.20[b]	0.20[b]
West of TA-53	1.00[b]	3.20	[d]	0.88	0.20[b]	8.60	0.01	5.80	14.00	0.20[b]	0.20[b]	0.20[b]
East of TA-53	1.00[b]	2.40	[d]	1.10	0.20[b]	5.90	0.02	4.90	14.00	0.20[b]	0.20[b]	0.20[b]
Potrillo Drive/TA-36	1.00[b]	2.80	[d]	0.66	0.20[b]	8.90	0.46	4.80	13.30	0.20[b]	0.20[b]	0.20[b]
East of TA-54	1.00[b]	1.50	[d]	0.74	0.20[b]	4.50	0.01	2.00[b]	10.00	0.20[b]	0.20[b]	0.20[b]
Near Test Well DT-9	1.00[b]	1.70	[d]	0.85	0.20[b]	8.50	0.01	5.90	15.00	0.20[b]	0.20[b]	0.20[b]
R-Site Road	1.00[b]	3.70	[d]	1.10	0.20[b]	12.00	0.02	5.90	15.70	0.20[b]	0.20[b]	0.20[b]
Two-Mile Mesa	1.00[b]	2.80	[d]	0.87	0.20[b]	10.00	0.02	6.60	13.00	0.20[b]	0.20[b]	0.40
Mean	1.00A	2.38A	[d]	0.87A	0.23A	7.69B	0.05A	5.20A	13.86B	0.20A	0.20A	0.22A
(std dev)	(0.00)	(0.72)		(0.16)	(0.09)	(2.48)	(0.13)	(1.74)	(2.78)	(0.00)	(0.00)	(0.06)

[a] Analysis by EPA Method 3051 for total recoverable metals.
[b] All less-than values were converted to one-half the concentration.
[c] Means within the same column followed by the same upper-case letter are not significantly different from one another using a Wilcoxon Rank Sum Test at the 0.05 probability level.
[d] Sample lost in analysis, not analyzed, or outlier omitted.
[e] Regional Statistical Reference Level; this is the upper (95%) limit background concentration (mean + 2 std dev) based on data from 1992 to 1999.
[f] Los Alamos National Laboratory Screening Action Level.

Table 6-4. Radionuclides in Produce Collected from Regional Background, Perimeter, and On-Site Locations during 1999[a]

Location	^{3}H (pCi/mL)	^{137}Cs (10^{-3} pCi/g dry)	^{90}Sr (10^{-3} pCi/g dry)	^{234}U (10^{-3} pCi/g dry)	^{235}U (10^{-4} pCi/g dry)	^{238}U (10^{-3} pCi/g dry)	^{238}Pu (10^{-5} pCi/g dry)	^{239}Pu (10^{-5} pCi/g dry)	^{241}Am (10^{-5} pCi/g dry)
Regional Background Stations									
Española/Santa Fe/Jemez:									
Cherries	e	0.00 (200.90)[c]	351.8 (139.2)	9.54 (0.91)	4.21 (2.74)	9.81 (0.90)	–49.00 (25.48)[b]	5.88 (19.60)	–29.40 (56.84)
Squash	e	16.64 (29.74)	352.4 (70.7)	5.20 (0.90)	0.00 (0.00)	3.07 (0.59)	–61.57 (37.99)	–44.54 (41.92)	–13.10 (10.48)
Corn	e	12.16 (10.50)	49.3 (26.9)	1.02 (0.32)	–0.58 (1.15)	0.65 (0.21)	5.76 (11.52)	17.92 (10.24)	–7.68 (4.48)
Apple	e	15.08 (14.76)	23.8 (8.64)	2.61 (0.28)	0.97 (0.72)	2.71 (0.28)	7.92 (6.84)	–5.04 (6.84)	–1.80 (1.44)
Cucumber	e	3.33 (14.76)	276.6 (67.8)	6.57 (0.93)	3.19 (3.59)	4.56 (0.73)	5.32 (19.95)	26.60 (19.95)	15.96 (6.65)
Tomatoes	e	3.70 (7.30)	–3.0 (37.0)	1.90 (0.48)	2.10 (2.00)	0.97 (0.33)	–11.00 (8.00)	24.00 (16.00)	–13.00 (8.00)
Mean (SD)	–0.03 (0.22)[f]	8.49 (7.00)	175.2 (169.4)	4.47 (3.24)	1.65 (1.86)	3.63 (3.35)	–17.10 (30.61)B[a]	4.14 (26.63)	–8.17 (14.98)
RSRL[d]	0.39	73.8	81.6	6.5	2.6	5.6	11.2	16.2	20.5
Perimeter Stations									
Los Alamos:									
Squash	e	8.25 (17.82)	125.8 (44.5)	0.69 (0.38)	0.26 (2.49)	1.01 (0.43)	89.09 (28.82)	32.75 (24.89)	–9.17 (5.24)
Apples	e	5.15 (4.86)	–0.7 (6.8)	–0.12 (0.13)	0.36 (0.86)	0.10 (0.10)	16.56 (7.56)	–7.20 (3.96)	–3.60 (2.16)
Plums	e	11.07 (5.90)	–32.0 (22.1)	0.64 (0.43)	2.34 (2.58)	0.68 (0.38)	43.05 (25.83)	7.38 (23.37)	7.38 (4.92)
Tomatoes	e	4.40 (10.10)	19.0 (18.0)	–0.05 (0.47)	–0.20 (1.60)	0.21 (0.20)	79.00 (20.00)	–9.00 (14.00)	–9.00 (7.00)
Peaches	e	–6.38 (62.09)	16.7 (16.0)	1.35 (0.33)	–0.23 (1.44)	1.02 (0.27)	148.20 (21.28)	2.28 (8.36)	–10.64 (6.84)
Mean (SD)	0.19 (0.36)[f]	4.50 (6.63)	25.8 (59.5)	0.50 (0.61)	0.51 (1.06)	0.60 (0.43)	75.18 (50.02)A	5.24 (16.79)	–5.01 (7.42)
White Rock/Pajarito Acres:									
Squash	e	12.71 (26.72)	221.4 (62.9)	1.51 (0.79)	1.83 (5.63)	0.56 (0.34)	403.48 (44.54)	3.93 (18.34)	–7.86 (5.24)
Squash	e	43.75 (28.95)	233.2 (59.0)	1.41 (0.47)	–2.49 (2.75)	1.70 (0.59)	153.27 (47.16)	5.24 (28.82)	–2.62 (3.93)
Tomatoes	e	5.90 (12.50)	60.0 (43.0)	0.27 (0.42)	–1.40 (3.70)	0.27 (0.20)	6.00 (18.00)	–9.00 (13.00)	7.00 (4.00)
Corn	e	19.14 (17.98)	46.7 (25.0)	0.24 (0.21)	0.32 (1.09)	0.01 (0.06)	45.44 (16.00)	–10.24 (10.24)	9.60 (3.84)
Apples	e	10.22 (6.88)	159.9 (56.2)	0.14 (0.16)	–0.76 (0.65)	0.11 (0.07)	3.60 (5.76)	6.48 (5.76)	1.08 (1.08)
Rhubarb	e	11.39 (6.24)	e	2.00 (0.71)	–1.09 (3.43)	1.86 (0.54)	187.98 (24.18)	15.60 (10.14)	–3.90 (3.12)
Mean (SD)	–0.03 (0.26)[f]	17.19 (13.70)	144.2 (87.6)	0.93 (0.81)	0.60 (1.50)	0.75 (0.82)	133.30 (153.06)A	2.00 (9.90)	0.55 (6.70)

Table 6-4. Radionuclides in Produce Collected from Regional Background, Perimeter, and On-Site Locations during 1999[a] (Cont.)

Location	^{3}H (pCi/mL)	^{137}Cs (10^{-3} pCi/g dry)	^{90}Sr (10^{-3} pCi/g dry)	^{234}U (10^{-3} pCi/g dry)	^{235}U (10^{-4} pCi/g dry)	^{238}U (10^{-3} pCi/g dry)	^{238}Pu (10^{-5} pCi/g dry)	^{239}Pu (10^{-5} pCi/g dry)	^{241}Am (10^{-5} pCi/g dry)
Cochiti:									
Corn	e	7.55 (10.62)	16.0 (20.5)	0.31 (0.46)	–0.26 (3.71)	0.38 (0.18)	48.64 (21.12)	–23.04 (16.00)	–3.84 (3.20)
Tomatoes	e	28.70 (18.80)	67.0 (36.0)	–0.22 (0.97)	–3.00 (6.50)	0.18 (0.28)	212.00 (38.00)	–37.00 (22.00)	–23.00 (27.00)
Apples	e	–4.75 (61.49)	40.3 (11.9)	0.28 (0.21)	–0.76 (1.37)	0.19 (0.12)	0.36 (5.76)	1.44 (5.40)	–4.68 (2.88)
Cucumbers	e	29.79 (34.45)	99.8 (49.2)	1.78 (0.58)	–0.40 (2.40)	2.30 (0.51)	236.74 (39.90)	–13.30 (25.27)	6.65 (5.32)
Chile	e	4.75 (14.97)	45.3 (27.0)	0.84 (0.68)	–2.41 (3.80)	0.47 (0.25)	–10.95 (7.30)	9.49 (9.49)	–5.84 (3.65)
Mean (SD)	0.04 (0.29)[f]	13.21 (15.34)	53.7 (31.5)	0.60 (0.76)	–1.37 (1.25)	0.70 (0.90)	97.36 (118.41)A	–12.48 (18.64)	–6.14 (10.67)
San Ildefonso Pueblo:									
Corn	e	–6.78 (114.69)	–9.0 (12.8)	0.45 (0.27)	–0.32 (0.83)	0.42 (0.18)	28.16 (16.64)	–24.96 (15.36)	–24.32 (414.08)
Squash	e	0.00 (213.79)	91.7 (38.0)	6.68 (1.07)	4.32 (3.67)	5.92 (0.81)	–20.96 (37.99)	–10.48 (37.99)	–18.34 (13.10)
Choke Cherry	e	–10.00 (43.81)	55.9 (23.5)	4.38 (0.65)	2.45 (2.45)	4.04 (0.60)	28.42 (17.64)	1.96 (12.74)	–15.68 (9.80)
Cucumbers	e	28.33 (31.92)	168.9 (41.2)	15.77 (1.37)	2.00 (2.40)	12.15 (1.20)	172.90 (30.59)	–15.96 (15.96)	–29.26 (19.95)
Tomatoes	e	–28.00 (101.00)	17.0 (19.0)	2.81 (0.58)	–0.20 (2.10)	2.32 (0.50)	80.00 (20.00)	–10.00 (9.00)	7.00 (4.00)
Mean (SD)	–0.12 (0.31)[f]	–3.29 (20.48)	64.9 (69.6)	6.02 (5.91)	1.65 (1.95)	4.97 (4.50)	57.70 (73.63)AC	–11.88 (9.81)	–16.12 (13.96)
On-Site Stations									
LANL (Mesa):									
Nectarines	e	3.82 (3.35)	4.7 (14.0)	0.28 (0.25)	–0.54 (0.93)	0.32 (0.16)	–0.78 (15.60)	10.14 (14.82)	14.04 (4.68)
Peaches	e	19.38 (8.59)	26.6 (16.0)	0.36 (0.36)	–0.53 (1.37)	0.26 (0.16)	30.40 (13.68)	4.56 (11.40)	1.52 (2.28)
Apples	e	0.00 (55.44)	27.4 (8.3)	0.50 (0.16)	–0.07 (0.82)	0.32 (0.11)	–0.36 (4.32)	6.12 (4.68)	1.08 (1.08)
Crab Apples	e	7.92 (5.88)	38.8 (10.4)	1.33 (0.26)	0.28 (0.60)	0.87 (0.20)	5.60 (7.20)	22.00 (10.40)	–0.40 (0.80)
Apples	e	5.58 (2.99)	4.7 (7.2)	0.15 (0.10)	0.43 (0.61)	0.22 (0.10)	4.32 (5.76)	5.04 (5.40)	–1.80 (1.44)
Mean (SD)	1.49 (1.11)[f]	7.34 (7.33)	20.4 (15.2)	0.52 (0.47)	–0.09 (0.45)	0.40 (0.27)	7.84 (12.92)BC	9.57 (7.29)	2.89 (6.37)

[a] There are no concentration guides for produce, and with the exception of ^{238}Pu, there were no statistical differences in any of the mean values from perimeter and on-site locations when compared with regional background at the 0.05 probability level using a Wilcoxon Rank Sum Test. Means within the same column for ^{238}Pu followed by the same upper-case letter are not significantly different from one another using a Wilcoxon Rank Sum Test at the 0.05 probability level.

[b] See Appendix B for an explanation of the presence of negative values.

[c] (±1 counting uncertainty); values are the uncertainty of the analytical results at the 65% confidence level.

[d] Regional Statistical Reference Level; this is the upper (95%) limit background concentration (mean + 2 std dev) based on data from 1993 to 1997.

[e] Sample lost in analysis, not analyzed, or outlier omitted.

[f] Average of 1994 to 1998 data.

Table 6-5. Tritium (Negatively Biased) Concentrations in Produce Collected from Regional Background, Perimeter, and On-Site Locations during 1999[a]

Location	^{3}H (pCi/mL)[b]	
Regional Background Stations		
Española/Santa Fe/Jemez:		
Cherries	0.06	(0.63)[c]
Squash	–0.10	(0.61)
Corn	0.01	(0.62)
Apple	–0.28	(0.60)
Cucumbers	–0.03	(0.62)
Tomatoes	–0.01	(0.62)
Mean (std dev)	–0.06	(0.12)A[d]
Perimeter Stations		
Los Alamos:		
Squash	–0.26	(0.60)
Apples	0.50	(0.66)
Plums	–0.10	(0.61)
Tomatoes	–0.05	(0.62)
Peaches	–0.28	(0.60)
Mean (std dev)	0.04	(0.32)A
White Rock/Pajarito Acres:		
Squash	–0.10	(0.61)
Squash	–0.11	(0.61)
Tomatoes	–0.30	(0.60)
Corn	–0.06	(0.62)
Apples	–0.12	(0.61)
Rhubarb	–0.20	(0.61)
Mean (std dev)	–0.15	(0.09)A
Cochiti:		
Corn	–0.21	(0.60)
Tomatoes	–0.12	(0.61)
Apples	–0.18	(0.61)
Cucumbers	–0.24	0.60)
Chile	–0.38	(0.59)
Mean (std dev)	–0.23	(0.08)A
San Ildefonso Pueblo:		
Corn	–0.11	(0.61)
Squash	–0.18	(0.61)
Choke Cherry	–0.25	(0.60)
Cucumbers	–0.16	(0.61)
Tomatoes	0.04	(0.62)
Mean (std dev)	–0.13	(0.11)A

Table 6-5. Tritium (Negatively Biased) Concentrations in Produce Collected from Regional Background, Perimeter, and On-Site Locations during 1999[a] (Cont.)

Location	^{3}H (pCi/mL)[b]	
On Site Stations		
LANL (Mesa):		
Nectarines	0.04	(0.62)
Peaches	2.56	(0.79)
Apples	0.94	(0.69)
Crab Apples	0.59	(0.66)
Apples	0.02	(0.62)
Mean (std dev)	0.81	(1.06)A

[a]Negatively biased data are defined as a data set that contains over 50% negative numbers and are considered invalid because of analytical laboratory problems; the data appear in this report for documentary purposes.

[b]pCi/mL of tissue moisure.

[c](±1 counting uncertainty); values are the uncertainty of the analytical results at the 65% confidence level.

[d]Means within the column followed by the same upper-case letter are not significantly different from one another using a Wilcoxon Rank Sum Test at the 0.05 probability level.

Table 6-6. Total Recoverable Trace Elements (μg/g dry) in Produce Collected from Regional Background, Perimeter, and On-Site Locations during 1999[a]

Location	Ag	As	Ba	Be	Cd	Cr	Hg	Ni	Pb	Se	Tl	Zn
Regional Background Stations												
Española/Santa Fe/Jemez:												
Cherry	1.00[b]	0.25[b]	5.30	0.10[b]	0.50[b]	0.50[b]	0.03[b]	1.00[b]	7.3	0.20[b]	0.20[b]	5.50
Squash	1.00[b]	0.25[b]	14.00	0.10[b]	0.50[b]	0.50[b]	0.03[b]	1.00[b]	2.2	0.20[b]	0.20[b]	33.00
Corn	1.00[b]	0.25[b]	0.42	0.10[b]	0.50[b]	0.50[b]	0.03[b]	20.00	34.3	0.20[b]	0.20[b]	33.00
Apple	1.00[b]	0.25[b]	0.65	0.10[b]	0.50[b]	0.50[b]	0.03[b]	1.00[b]	2.1	0.20[b]	0.20[b]	1.20
Cucumber	1.00[b]	0.25[b]	13.00	0.10[b]	0.50[b]	2.30	0.03[b]	2.10	2.6	0.20[b]	0.20[b]	29.00
Tomato	1.00[b]	0.25[b]	12.00	0.10[b]	0.50[b]	0.50[b]	0.03[b]	1.00[b]	2.9	0.20[b]	0.20[b]	15.00
Mean	1.00	0.25	7.56	0.10	0.50	0.80	0.03	4.35	8.6	0.20	0.20	19.45
(std dev)	(0.00)	(0.00)	(6.24)	(0.00)	(0.00)	(0.73)	(0.00)	(7.68)	(12.8)	(0.00)	(0.00)	(14.18)
RSRL[c]	1.38	0.66	27.43	0.53	0.46	3.98	0.06	23.50	22.0	0.3	0.20	30.3
Perimeter Stations												
Los Alamos:												
Squash	1.00[b]	0.25[b]	9.80	0.10[b]	0.50[b]	0.50[b]	0.03[b]	15.00	24.0	0.20[b]	0.20[b]	48.00
Apple	1.00[b]	0.25[b]	5.00	0.10[b]	0.50[b]	0.50[b]	0.03[b]	0.10[b]	4.1	0.20[b]	0.20[b]	2.50
Plum	1.00[b]	0.25[b]	2.10	0.10[b]	0.50[b]	0.50[b]	0.03[b]	0.10[b]	8.0	0.20[b]	0.20[b]	7.20
Tomato	1.00[b]	0.25[b]	2.30	0.10[b]	0.50[b]	0.50[b]	0.03[b]	1.00[b]	9.0	0.20[b]	0.20[b]	15.00
Peach	1.00[b]	0.25[b]	4.40	0.10[b]	0.50[b]	0.50[b]	0.03[b]	1.00[b]	0.8	0.20[b]	0.20[b]	8.10
Mean	1.00	0.25	4.72	0.10	0.50	0.50	0.03	3.44	9.2	0.20	0.20	16.16
(std dev)	(0.00)	(0.00)	(3.11)	(0.00)	(0.00)	(0.00)	(0.00)	(6.48)	(8.9)	(0.00)	(0.00)	(18.35)
White Rock /Pajarito Acres:												
Squash	1.00[b]	0.25[b]	5.40	0.10[b]	0.50[b]	0.50[b]	0.03[b]	16.00	11.1	0.20[b]	0.20[b]	27.00
Squash	1.00[b]	0.25[b]	6.30	0.10[b]	0.50[b]	1.00	0.03[b]	1.00[b]	1.9	0.20[b]	0.20[b]	32.00
Tomato	1.00[b]	0.25[b]	1.80	0.10[b]	0.50[b]	0.50[b]	0.03[b]	1.00[b]	2.9	0.20[b]	0.20[b]	22.00
Corn	1.00[b]	0.25[b]	0.24	0.10[b]	0.50[b]	0.50[b]	0.03[b]	1.00[b]	19.0	0.20[b]	0.20[b]	27.00
Apple	1.00[b]	0.25[b]	2.50	0.10[b]	0.50[b]	0.50[b]	0.03[b]	1.00[b]	7.0	0.20[b]	0.20[b]	1.90
Rhubarb	1.00[b]	0.25[b]	27.00	0.10[b]	0.50[b]	0.50[b]	0.03[b]	1.00[b]	3.0	0.20[b]	0.20[b]	10.00
Mean	1.00	0.25	7.21	0.10	0.50	0.58	0.03	3.50	7.5	0.20	0.20	19.98
(std dev)	(0.00)	(0.00)	(9.96)	(0.00)	(0.00)	(0.20)	(0.00)	(6.12)	(6.6)	(0.00)	(0.00)	(11.61)

Table 6-6. Total Recoverable Trace Elements (µg/g dry) in Produce Collected from Regional Background, Perimeter, and On-Site Locations during 1999[a] (Cont.)

Location	Ag	As	Ba	Be	Cd	Cr	Hg	Ni	Pb	Se	Tl	Zn
Cochiti/Peña Blanca/Santo Domingo:												
Corn	1.00[b]	0.25[b]	0.36	0.10[b]	0.50[b]	0.50[b]	0.03[b]	3.40	8.1	0.20[b]	0.20[b]	27.00
Tomato	1.00[b]	0.25[b]	2.40	0.10[b]	0.50[b]	0.50[b]	0.03[b]	3.00	7.9	0.20[b]	0.20[b]	14.00
Apple	1.00[b]	0.25[b]	1.00	0.10[b]	0.50[b]	1.60	0.03[b]	1.00[b]	1.2	0.20[b]	0.20[b]	3.10
Cucumber	1.00[b]	0.25[b]	17.00	0.10[b]	0.50[b]	0.50[b]	0.03[b]	1.00[b]	1.9	0.20[b]	0.20[b]	34.00
Chile	1.00[b]	0.25[b]	1.00	0.10[b]	0.50[b]	0.50[b]	0.03[b]	3.20	4.9	0.20[b]	0.20[b]	17.00
Mean	1.00	0.25	4.35	0.10	0.50	0.72	0.03	2.32	4.8	0.20	0.20	19.02
(std dev)	(0.00)	(0.00)	(7.11)	(0.00)	(0.00)	(0.49)	(0.00)	(1.21)	(3.2)	(0.00)	(0.00)	(11.95)
San Ildefonso Pueblo:												
Corn	1.00[b]	0.25[b]	0.53	0.10[b]	0.50[b]	0.50[b]	0.03[b]	2.90	15.1	0.20[b]	0.20[b]	26.00
Squash	1.00[b]	0.25[b]	13.00	0.10[b]	0.50[b]	0.50[b]	0.03[b]	1.00[b]	4.4	0.20[b]	0.20[b]	26.00
Plum	1.00[b]	0.25[b]	1.50	0.10[b]	0.50[b]	0.50[b]	0.03[b]	17.00	6.8	0.20[b]	0.20[b]	4.00
Cucumber	1.00[b]	0.25[b]	21.00	0.10[b]	0.50[b]	0.50[b]	0.03[b]	1.00[b]	1.5	0.20[b]	0.20[b]	28.00
Tomato	1.00[b]	0.25[b]	2.20	0.10[b]	0.50[b]	0.50[b]	0.03[b]	1.00[b]	6.9	0.20[b]	0.20[b]	14.00
Mean	1.00	0.25	7.65	0.10	0.50	0.05	0.03	4.58	6.9	0.20	0.20	19.60
(std dev)	(0.00)	(0.00)	(9.01)	(0.00)	(0.00)	(0.00)	(0.00)	(6.99)	(5.1)	(0.00)	(0.00)	(10.33)
On-Site Stations												
LANL:												
Nectarine	1.00[b]	0.25[b]	6.40	0.10[b]	0.50[b]	0.50[b]	0.03[b]	1.00[b]	6.3	0.20[b]	0.20[b]	8.30
Peach	1.00[b]	0.25[b]	2.90	0.10[b]	0.50[b]	0.50[b]	0.03[b]	1.00[b]	2.7	0.20[b]	0.20[b]	9.10
Apple	1.00[b]	0.25[b]	3.90	0.10[b]	0.50[b]	0.50[b]	0.03[b]	1.00[b]	2.8	0.20[b]	0.20[b]	5.50
Crab apple	1.00[b]	0.25[b]	15.00	0.10[b]	0.50[b]	0.50[b]	0.03[b]	1.00[b]	5.7	0.20[b]	0.20[b]	5.00
Apple	1.00[b]	0.25[b]	4.10	0.10[b]	0.50[b]	0.50[b]	0.03[b]	1.00[b]	6.5	0.20[b]	0.20[b]	2.00
Mean	1.00	0.25	6.46	0.10	0.50	0.50	0.03	1.00	4.8	0.20	0.20	5.98
(std dev)	(0.00)	(0.00)	(4.94)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(1.9)	(0.00)	(0.00)	(2.83)

[a] Analysis by EPA Method 3051 for total recoverable metals, and there were no statistical differences in any of the mean concentrations form perimeter and on-site locations as compared with regional background at the 0.05 probability level using a Wilcoxon Rank Sum Test.

[b] Less-than values were converted to one-half the concentration.

[c] Regional Statistical Reference Level; this is the upper (95%) limit background concentration (mean + 2 std dev) based on data from 1994 to 1996.

Table 6-7. Radionuclides in Eggs Collected from Regional Background and Perimeter Locations during 1999[a]

Radionuclide	Perimeter: San Ildefonso Pueblo	Perimeter: Los Alamos Townsite	Perimeter: White Rock Pajarito Acres	Regional Background: Española	Regional Background: RSRL[d]
^{238}Pu (pCi/L)	0.0124 (0.0068)[b]	–0.0003 (0.0058)[c]	0.0662 (0.0119)	0.0018 (0.0049)	0.045
^{239}Pu (pCi/L)	0.0202 (0.0100)	0.0291 (0.0102)	0.0322 (0.0100)	–0.0014 (0.0041)	0.158
^{90}Sr (pCi/L)	5.14 (0.73)	6.64 (0.75)	9.73 (0.89)	11.05 (1.01)	13.54
Total U (µg/L)	0.12 (0.01)	0.17 (0.02)	0.10 (0.01)	0.13 (0.01)	0.69
Tritium (pCi/mL)	0.16 (0.63)	0.41 (0.64)	0.06 (0.62)	0.03 (0.62)	0.47
^{137}Cs (pCi/L)	5.4 (14.9)	3.5 (11.3)	3.5 (5.8)	3.7 (14.1)	20.53
^{241}Am (pCi/L)	0.0119 (0.0053)	0.0066 (0.0028)	0.0144 (0.0054)	0.0224 (0.0069)	0.035

[a] 1L is equal to approximately 24 eggs, and the density of eggs is approximately 1,135 g/L.
[b](±1 counting uncertainty); values are the uncertainty of the analytical results at the 65% confidence level.
[c] See Appendix B for an explanation of the presence of negative values.
[d]Regional Statistical Reference Level; this is the upper (95%) limit background concentration (mean + 2 std dev) based on data from 1995 to 1999.

Table 6-8. Radionuclides in Goat's Milk Collected from Regional Background and Perimeter Locations during 1999

Radionuclide	Perimeter: Los Alamos		Perimeter: White Rock/Pajarito Acres		Regional Background: Albuquerque		Regional Background: RSRL[a]
^{238}Pu (pCi/L)	–0.0179	(0.0145)[b,c]	0.0071	(0.0083)	–0.0240	(0.0137)	0.011
^{239}Pu (pCi/L)	–0.0098	(0.0135)	0.0064	(0.0060)	–0.0146	(0.0075)	0.020
^{90}Sr (pCi/L)	2.81	(0.54)	2.04	(0.35)	0.86	(0.21)	6.95
Total U (µg/L)		[d]		[d]		[d]	0.85
Tritium (pCi/mL)	0.28	(0.63)	0.31	(0.63)	–0.70	(0.61)	0.07
^{137}Cs (pCi/L)	–8.40	(104.00)	14.00	(10.00)	7.70	(12.00)	19.0
^{131}I (pCi/L)	0.00	(98.00)	19.00	(10.00)	–4.00	(77.00)	15.4
^{241}Am (pCi/L)	–0.014	(0.23)	0.054	(0.017)	–0.011	(0.059)	0.11

[a]Regional Statistical Reference Level; this is the upper (95%) limit background (mean + 2 std dev) based on data from 1994 to 1998.
[b](±1 counting uncertainty); values are the uncertainty of the analytical results at the 65% confidence level.
[c]See Appendix B for an explanation of the presence of negative values.
[d]Sample lost in analysis, not analyzed, or outlier omitted.

Table 6-9. Radionuclides in Game and Nongame Fish Upstream and Downstream of Los Alamos National Laboratory during 1999

Location	^{3}H[a] (pCi/mL)	^{90}Sr (10^{-2} pCi/g dry)	^{137}Cs (10^{-2} pCi/g dry)	^{tot}U (ng/g dry)	^{238}Pu (10^{-5} pCi/g dry)	^{239}Pu (10^{-5} pCi/g dry)	^{241}Am (10^{-5} pCi/g dry)
Game Fish							
Upstream (Abiquiu, Heron, and El Vado):							
Crappie	[b]	1.45 (3.03)[c]	0.50 (0.61)	2.42 (1.21)	13.31 (10.89)	43.56 (18.15)	[b]
Crappie	[b]	4.72 (3.27)	1.17 (0.85)	3.63 (1.21)	9.68 (15.73)	14.52 (15.73)	[b]
Crappie	[b]	–1.09 (3.27)[d]	0.61 (0.24)	2.42 (1.21)	10.89 (12.10)	10.89 (13.31)	[b]
Walleye	[b]	1.21 (2.54)	1.33 (0.36)	2.42 (1.21)	10.89 (8.47)	20.57 (13.31)	[b]
Mean (std dev)	0.00 (0.30)[e]	1.57 (2.39)A[f]	0.90 (0.41)A	2.72 (0.61)A	11.19 (1.52)A	22.39 (14.67)A	22.3 (21.6)[g]
RSRL[h]	0.20	17.00	27.70	6.50	23.6	28.3	28.90
Downstream (Cochiti):							
Crappie	[b]	5.81 (2.90)	0.57 (0.19)	7.26 (1.21)	2.42 (29.04)	27.83 (25.41)	[b]
Crappie	[b]	5.81 (2.66)	0.24 (0.96)	6.05 (1.21)	62.92 (55.66)	60.50 (59.29)	[b]
Pike	[b]	0.73 (2.90)	0.00 (1.75)	2.42 (1.21)	12.10 (13.31)	7.26 (18.15)	[b]
Pike/Bass	[b]	5.08 (3.39)	0.00 (1.48)	3.63 (1.21)	[b]	[b]	[b]
Walleye	[b]	1.21 (2.90)	1.89 (0.30)	3.63 (1.21)	–7.26 (22.99)	26.62 (23.00)	[b]
Mean (std dev)	0.23 (0.40)[e]	3.73 (2.54)A	0.54 (0.79)A	4.60 (1.99)A	17.55 (31.27)A	30.55 (22.08)A	67.9 (103.3)[g]
Nongame Fish							
Upstream (Abiquiu, Heron, and El Vado):							
Catfish	[b]	4.66 (3.23)	0.38 (0.19)	12.35 (0.95)	0.95 (9.50)	7.60 (9.50)	[b]
Catfish	[b]	1.43 (2.95)	0.00 (2.51)	13.30 (0.95)	–2.85 (19.95)	0.00 (18.05)	[b]
Catfish	[b]	5.23 (3.04)	–0.04 (1.59)	13.30 (0.95)	–5.70 (24.70)	12.35 (33.25)	[b]
White Sucker	[b]	7.98 (3.04)	0.54 (0.29)	4.75 (0.95)	52.25 (37.05)	29.45 (26.60)	[b]
Carp	[b]	7.03 (2.57)	0.23 (0.19)	12.35 (0.95)	–5.70 (14.25)	–1.90 (15.20)	[b]
Carp	[b]	5.13 (2.10)	0.34 (0.19)	5.70 (0.95)	–23.75 (16.15)	18.08 (21.85)	[b]
Mean (std dev)	–0.03 (0.19)[e]	5.24 (2.26)A	0.24 (0.23)A	10.29 (3.96)A	2.53 (25.81)A	10.93 (11.76)A	14.4 (12.2)[g]
RSRL[h]	0.20	13.20	26.90	16.20	9.80	19.20	16.14

Table 6-9. Radionuclides in Game and Nongame Fish Upstream and Downstream of Los Alamos National Laboratory during 1999 (Cont.)

Location	^{3}H[a] (pCi/mL)	^{90}Sr (10^{-2} pCi/g dry)	^{137}Cs (10^{-2} pCi/g dry)	^{tot}U (ng/g dry)	^{238}Pu (10^{-5} pCi/g dry)	^{239}Pu (10^{-5} pCi/g dry)	^{241}Am (10^{-5} pCi/g dry)
Downstream (Cochiti):							
Catfish	b	0.19 (2.00)	0.00 (2.36)	14.25 (1.90)	7.60 (7.60)	19.95 (11.40)	b
White Sucker	b	5.61 (2.47)	0.00 (1.11)	6.65 (0.95)	9.50 (12.35)	27.55 (14.25)	b
Carp	b	2.95 (2.57)	0.20 (2.47)	26.60 (2.85)	4.75 (9.50)	10.45 (10.45)	b
Carp	b	7.98 (2.66)	0.33 (1.19)	29.45 (2.85)	17.10 (7.60)	43.70 (12.35)	b
Carp	b	6.08 (2.66)	–0.28 (5.00)	28.50 (2.85)	18.05 (17.10)	12.35 (15.20)	b
Mean (std dev)	0.40 (0.50)[e]	4.56 (3.03)A	0.05 (0.23)A	21.09 (10.13)A	11.40 (5.89)A	22.80 (13.50)A	30.2 (42.7)[g/]

[a] pCi/mL of tissue moisture.
[b] Sample lost in analysis, not analyzed, or outlier omitted.
[c] (±1 counting uncertainty); values are the uncertainty of the analytical results at the 65% confidence level.
[d] See Appendix B for an explanation of the presence of negative values.
[e] Data from 1995 to 1998.
[f] Means within the same column and fish type followed by the same upper-case letter are not significantly different from one another using a Wilcoxon Rank Sum Test at the 0.05 probability level.
[g] Data from 1996 to 1998.
[h] Regional Statistical Reference Level; this is the upper (95%) limit background concentration (mean + 2 std dev) based on data from 1981–1999.

Table 6-10. Tritium and Americium-241 (Negatively Biased) Concentrations in Game and Nongame Fish Upstream and Downstream of Los Alamos National Laboratory during 1999[a]

Location	^{3}H (pCi/mL)[b]		^{241}Am (10^{-5} pCi/g dry)	
Game Fish				
Upstream (Abiquiu, Heron, El Vado):				
Crappie	–0.09	(0.60)[c]	–84.70	(263.78)
Crappie	–0.18	(0.59)	–21.78	(49.61)
Crappie	–0.28	(0.58)	–49.61	(268.62)
Walleye	–0.08	(0.60)	2.42	(6.05)
Mean (std dev)	–0.16	(0.09)A[d]	–38.42	(37.47)A
Downstream (Cochiti):				
Crappie	0.02	(0.60)	–6.05	(8.47)
Crappie	–0.34	(0.57)	–64.13	(119.79)
Pike	–0.17	(0.59)	–1.21	(4.84)
Pike/Bass	–0.51	(0.56)	–32.67	(110.11)
Walleye	–0.26	(0.58)	–55.66	(111.32)
Mean (std dev)	–0.25	(0.20)A	–31.94	(28.35)A
Nongame Fish				
Upstream (Abiquiu, Heron, El Vado:				
Catfish	–0.18	(0.59)	–31.35	(28.50)
Catfish	–0.16	(0.59)	–40.85	(216.60)
Catfish	–0.22	(0.59)	–38.00	(19.95)
White Sucker	–0.03	(0.61)	–14.25	(19.00)
Carp	–0.21	(0.59)	8.55	(9.50)
Carp	–0.42	(0.57)	–34.20	(537.70)
Mean (std dev)	–0.20	(0.13)A	–25.02	(18.90)A
Downstream (Cochiti):				
Catfish	–0.12	(0.59)	–44.65	(38.95)
White Sucker	–0.08	(0.59)	–11.40	(7.60)
Carp	–0.15	(0.59)	–42.75	(30.40)
Carp	–0.09	(0.59)	–42.75	(42.75)
Carp	–0.35	(0.57)	1.90	(4.75)
Means (std dev)	–0.16	(0.11)A	–27.93	(21.69)A

[a] Negatively biased data are defined as a data set that contains over 50% negative numbers and are considered invalid because of analytical laboratory problems; the data appear in this report for documentary purposes.

[b] pCi/mL of tissue moisture.

[c] (±1 counting uncertainty); values are the uncertainty of the analytical results at the 65% confidence level.

[d] Means within the same column and fish type followed by the same upper-case letter are not significantly different from one another using a Wilcoxon Rank Sum Test at the 0.05 probability level.

Table 6-11. Total Recoverable Mercury in Bottom-Feeding Fish (μg/g wet) Collected Upstream and Downstream of Los Alamos National Laboratory in 1999

Abiquiu Reservoir (Background)	Cochiti Reservoir	RSRL[a]
0.28 (catfish)	0.17 (catfish)	
0.20 (catfish)	0.05 (white sucker)	
0.23 (catfish)	0.11 (carp)	
0.06 (white sucker)	0.28 (carp)	
0.42 (carp)	0.11 (carp)	
0.22 (carp)		
0.24 (0.12)A[b]	0.14 (0.09)B	0.41

[a] Regional Statistical Reference Level; this is the upper (95%) limit background concentration (mean + 2 std dev) based on data from 1991 to 1996.
[b] Means within the same row followed by the same upper-case letter are not significantly different from one another using a Students-test on log-transformed data at the 0.05 probabibility level.

Table 6-12. Radionuclides in Muscle and Bone Tissues of Elk Collected from On-Site and Regional Background Areas during 1998 and 1999

Tissue/Location/Date/Sample	^{3}H[a] (pCi/mL)	^{tot}U (ng/g dry)	^{137}Cs (10^{-3} pCi/g dry)	^{90}Sr (10^{-3} pCi/g dry)	^{238}Pu (10^{-5} pCi/g dry)	^{239}Pu (10^{-5} pCi/g dry)	^{241}Am (10^{-5} pCi/g dry)
Muscle:							
LANL Elk							
TA-8/Anchor West Road/6-25-99/Cow	0.08 (0.61)[b]	0.44 (0.44)	0.0 (17.4)	24.6 (20.7)	–4.0 (7.0)	2.2 (6.2)	8.8 (3.1)
WR/PA/State Road 4/10-19-98/Bull	–0.01 (0.63)[c]	0.44 (0.44)	3.3 (0.8)	3.5 (6.6)	4.8 (8.4)	15.4 (11.9)	–19.4 (14.5)
Mean (std dev)	0.04 (0.06)	0.44 (0.00)	1.7 (2.3)	14.1 (14.9)	0.4 (6.2)	8.8 (9.3)	–5.3 (19.9)
Regional Background Elk							
Mean (std dev)	0.21 (0.16)	0.83 (0.68)	95.1 (113.1)	0.7 (1.6)	–1.1 (2.5)	–0.5 (1.0)	4.4 (5.1)
RSRL[e]	0.53	2.19	321.4	3.9	3.9	1.6	14.5
Leg Bone:							
LANL Elk							
TA-8/Anchor West Road/6-25-99/Cow	0.05 (0.61)	5.80 (5.80)	0.0 (16.8)	1972.0 (226.2)	–58.0 (58.0)	116.0 (75.4)	[d]
WR/PA/State Road 4/10-19-98/Bull	0.01 (0.63)	5.80 (5.80)	1.8 (4.2)	2035.8 (203.0)	904.8 (475.6)	11.6 (319.0)	[d]
Mean (std dev)	0.03 (0.03)	5.80 (0.00)	0.9 (1.3)	2003.9 (45.1)	423.4 (680.8)	63.8 (73.8)	[d]
Regional Background Elk							
Mean (std dev)	–0.01 (0.26)	2.29 (1.96)	43.1 (77.5)	1300.7 (882.5)	13.7 (47.5)	–6.0 (8.2)	41.0 (5.3)
RSRL[e]	0.51	6.21	198.2	3065.7	108.8	10.4	51.6

[a] pCi/mL of tissue moisture.
[b] (±1 counting uncertainty); values are the uncertainty of the analytical results at the 65% confidence level.
[c] See Appendix B for an explanation of the presence of negative values.
[d] Sample lost in analysis, not analyzed, or outlier omitted.
[e] The mean (std dev) and the Regional Statistical Reference Level the upper (95%) limit background concentration (mean + 2 std dev) is based from 1991 to 1998 (Fresquez et al., 1998).

Table 6-13. Radionuclides in Muscle and Bone Tissues of Deer Collected from On-Site Locations and Regional Background Areas during 1999

Tissue/Location/Date/Sample	^{3}H[a] (pCi/mL)	^{tot}U (ng/g dry)	^{137}Cs (10^{-3} pCi/g dry)	^{90}Sr (10^{-3} pCi/g dry)	^{238}Pu (10^{-5} pCi/g dry)	^{239}Pu (10^{-5} pCi/g dry)	^{241}Am (10^{-5} pCi/g dry)
Muscle:							
LANL Deer							
TA-15/West of Q-Site/10-14-99/Buck	–0.1 (0.65)[b,c]	0.75 (0.37)	23.6 (7.02)	[d]	10.8 (8.1)	16.2 (7.7)	5.9 (2.7)
Regional Background Deer							
Mean (std dev)	0.15 (0.25)	1.10 (0.66)	14.5 (7.3)	14.2 (12.3)	–1.8 (2.8)	3.5 (5.7)	6.2 (10.7)
RSRL[e]	0.65	2.42	29.0	38.8	3.7	14.8	27.5
Leg Bone:							
LANL Deer							
TA-15/West of Q-Site/10-14-99/Buck	–0.01 (0.66)	3.44 (2.45)	6.6 (16.3)	1663.2 (167.2)	928.4 (347.6)	–145.2 (268.4)	[d]
Regional Background Deer							
Mean (std dev)	0.07 (0.25)	2.03 (2.10)	10.3 (25.7)	907.5 (106.1)	–5.9 (10.2)	0.6 (1.0)	59.5 (28.5)
RSRL[e]	0.57	6.23	61.8	1119.7	14.5	2.7	116.5

[a] pCi/mL of tissue moisture.
[b] (±1 counting uncertainty); values are the uncertainty of the analytical results at the 65% confidence level.
[c] See Appendix B for an explanation of the presence of negative values.
[d] Sample lost in analysis, not analyzed, or outlier omitted.
[e] Regional Statistical Reference Level; this is the upper (95%) limit background concentration (mean + 2 std dev) based on data from 1991 to 1998 (Fresquez et al., 1998).

Table 6-14. Radionuclides in Muscle and Bone of a Free-Range Beef Cattle Collected from the San Ildefonso Pueblo and Regional Background during 1999

Tissue/Location	^{3}H[a] (pCi/mL)	^{tot}U (ng/g dry)	^{137}Cs (10^{-3} pCi/g dry)	^{90}Sr (10^{-3} pCi/g dry)	^{238}Pu (10^{-5} pCi/g dry)	^{239}Pu (10^{-5} pCi/g dry)	^{241}Am (10^{-5} pCi/g dry)
Muscle:							
Pueblo Cattle							
San Ildefonso	–0.46 (0.60)[b,c]	0.74 (0.37)	42.6 (6.7)	57.7 (13.3)	14.8 (4.1)	13.0 (4.4)	1.9 (14.1)
Regional Background[d]	0.19 (0.18)	1.30 (0.26)	16.4 (20.3)	–1.5 (10.5)	–2.8 (8.1)	–4.8 (10.5)	–7.8 (27.2)
RSRL[e]	0.55	1.82	57.0	19.5	13.4	16.2	46.6
Leg Bone:							
Pueblo Cattle							
San Ildefonso	–0.07 (0.63)	10.00 (5.00)	15.0 (5.0)	3,125.0 (295.0)	75.0 (60.0)	235.0 (70.0)	355.0 (135.0)
Regional Background[d]	–0.29 (0.33)	5.00 (0.00)	14.8 (14.5)	3,420.0 (3,068.8)	–145.0 (155.6)	–195.0 (169.7)	–95.5 (314.7)
RSRL[e]	0.37	5.00	43.8	9,557.7	166.1	144.4	533.8

[a] pCi/mL of tissue moisture.
[b] (±1 one counting uncertainty); values are the uncertainty of the analytical results at the 65% confidence level.
[c] See Appendix B for an explanation of the presence of negative values.
[d] Background from El Rito and Jemez, NM.
[e] Regional Statistical Reference Level; this is the upper (95%) limit background concentration (mean + 2 std dev).

Table 6-15. Radionuclides in Navajo Tea (Cota) Collected from Regional and Perimeter Locations during 1999

	^{3}H (pCi/mL)	^{90}Sr (pCi/L)	^{238}Pu (pCi/L)	^{239}Pu (pCi/L)	^{137}Cs (pCi/L)	^{tot}U (μg/L)	^{241}Am (pCi/L)
Regional Background:							
Española/Santa Fe/Jemez	–0.05 (0.59)[a,b]	1.01 (0.69)	0.018 (0.012)	0.025 (0.013)	–8.6 (127)	0.67 (0.07)	0.029 (0.018)
RSRL[c]	0.13	2.55	0.024	0.039	27.9	5.12	0.085
Off-Site Perimeter:							
San Ildefonso	–0.06 (0.59)	–0.01 (0.47)	–0.002 (0.005)	0.009 (0.008)	12.0 (18)	0.73 (0.07)	0.027 (0.011)
Los Alamos Townsite	0.06 (0.59)	0.56 (0.50)	0.014 (0.011)	0.022 (0.012)	1.9 (19)	0.76 (0.08)	0.007 (0.006)
White Rock/Pajarito Acres	0.09 (0.61)	0.47 (0.50)	0.002 (0.015)	0.004 (0.009)	–12.0 (127)	0.31 (0.03)	0.013 (0.018)

[a] See Appendix B for an explanation of the presence of negative values.
[b] (±1 counting uncertainty); values are the uncertainty of the analytical results at the 65% confidence level.
[c] Regional Statistical Reference Level; this is the upper (95%) limit background concentration (mean + 2 std dev) based on data from 1996 to 1999.

Table 6-16. Radionuclides in Piñon Shoot Tips (Vegetation) Collected from Regional Background and Perimeter Areas during the 1999 Growing Season[a]

Location	^{3}H (pCi/mL)	^{tot}U (ng/g dry)	^{137}Cs (10^{-3} pCi/g dry)	^{90}Sr (10^{-3} pCi/g dry)	^{238}Pu (10^{-5} pCi/g dry)	^{239}Pu (10^{-5} pCi/g dry)	^{241}Am (10^{-5} pCi/g dry)
Regional Background:							
Española/Santa Fe/Jemez	–0.40 (0.57)[b,c]	19.2 (1.6)	12.0 (33.6)	444.8 (45.6)	–36.8 (82.4)	155.2 (68.0)	–8.8 (7.2)
RSRL[d]	0.21	102.3	23.4	739.1	68.2	217.6	214.4
Off-Site Perimeter:							
San Ildefonso	–0.11 (0.59)	20.0 (2.4)	23.4 (16.9)	293.0 (31.2)	–24.8 (56.8)	17.6 (57.6)	11.2 (7.2)
Los Alamos Townsite	–0.11 (0.59)	44.8 (4.8)	–15.2 (203.2)	380.0 (48.0)	–17.6 (98.4)	–12.8 (96.8)	10.4 (8.0)
White Rock/Pajarito Acres	0.06 (0.60)	33.6 (3.2)	42.6 (13.4)	364.8 (42.8)	–16.0 (41.6)	58.4 (60.0)	57.6 (16.0)

[a] These are the shoot tips of the piñon tree and are not piñon nuts.
[b] (±1 counting uncertainty); values are the uncertainty of the analytical results at the 65% confidence level.
[c] See Appendix B for an explanation of the presence of negative values.
[d] Regional Statistical Reference Level; this is the upper (95%) limit background concentration (mean + 2 std dev) based on data from 1997 to 1999.

Table 6-17. Radionuclide Concentrations in Piñon Pine Nuts from Los Alamos National Laboratory and Background Locations during the 1999 Growing Season

Location	^{3}H (pCi/mL)	^{137}Cs (10^{-3} pCi/g dry)	^{90}Sr (10^{-3} pCi/g dry)	^{tot}U (ng/g dry)	^{238}Pu (10^{-5}pCi/g dry)	^{239,240}Pu (10^{-5}pCi/g dry)	^{241}Am (10^{-5} pCi/g dry)
On-Site Stations:							
TA-15	5.90 (0.99)[a]	–3.9 (2.9)[b]	[e]	1.56 (0.26)	0.52 (2.1)	5.98 (3.4)	13.0 (5.2)
TA-36	11.90 (1.30)	–4.7 (2.9)	[e]	1.30 (0.26)	1.30 (1.8)	5.98 (2.9)	5.5 (4.7)
TA-39	11.20 (1.20)	11.2 (2.1)	[e]	1.04 (0.26)	–2.60 (3.1)	–3.64 (3.9)	12.7 (5.5)
TA-49	11.00 (1.20)	13.5 (2.1)	[e]	1.30 (0.26)	–0.26 (2.1)	4.16 (3.4)	7.8 (4.7)
Mean (±SD)	10.00 (2.78)A[c]	4.0 (9.7)A		1.30 (0.21)A	–0.26 (1.7)A	3.12 (4.6)A	9.8 (3.7)A
Regional Background:							
Coyote	7.00 (1.00)	0.0 (2.9)	[e]	1.04 (0.26)	1.30 (2.6)	5.72 (2.6)	13.8 (4.4)
Tres Piedras	–0.01 (0.65)	12.0 (18.0)	[e]	0.78 (0.26)	–1.30 (6.2)	4.42 (4.9)	8.3 (3.4)
Jemez	0.61 (0.69)	17.4 (26.0)	[e]	1.82 (0.26)	–2.60 (1.8)	0.78 (2.6)	4.9 (3.9)
Mean (±SD)	2.53 (3.88)A	9.8 (8.9)A		1.21 (0.54)A	–0.87 (2.0)A	3.64 (2.6)A	9.0 (4.5)A
RSRL[d]	10.29	27.6		2.29	3.13	8.84	18.0

[a](±1 counting uncertainty); values are the uncertainty of the analytical results at the 65% confidence level.
[b]See Appendix B for an explanation of the presence of negative values.
[c]Means within the same column followed by the same upper-case letter are not significantly different at the 0.10 probability level using a nonparametric Wilcoxon Rank Sum Test.
[d]Regional Statistical Reference Level; this is the upper (95%) limit background concentration (mean + 2 std dev) based on data from 1998 (Fresquez et al., 2000).
[e]Sample lost in analysis, not analyzed, or outlier omitted (negatively biased).

Table 6-18. Strontium-90 (Negatively Biased) Concentrations in Piñon Pine Nuts from Los Alamos National Laboratory and Background Locations during 1999[a]

Location	^{90}Sr (10^{-3}pCi g dry)
On-Site Stations:	
TA-15	–15.6 (13.3)[b]
TA-36	–12.0 (6.8)
TA-39	–11.2 (7.3)
TA-49	–9.4 (8.6)
Mean (±SD)	–12.0 (2.6)A[c]
Regional Background:	
Coyote	–14.6 (10.4)
Tres Piedras	–21.8 (8.1)
Jemez	–38.0 (11.4)
Mean (±SD)	–24.8 (12.0)A

[a] Negatively biased data are defined as a data set that contains over 50% negative numbers and are considered invalid because of analytical laboratory problems; the data appear in this report for documentary purposes.
[b] (±1 counting uncertainty); values are the uncertainty of the analytical results at the 65% confidence level.
[c] Means within the column followed by the same upper-case letter are not significantly different from one another using a Wilcoxon Rank Sum Test at the 0.10 probability level.

Table 6-19. Radionuclides in Wild Spinach Collected from Regional Background and Perimeter Areas during the 1999 Growing Season

Location	^{3}H (pCi/mL)	^{tot}U (ng/g dry)	^{137}Cs (10^{-3} pCi/g dry)	^{90}Sr (10^{-3} pCi/g dry)	^{238}Pu (10^{-5} pCi/g dry)	^{239}Pu (10^{-5} pCi/g dry)	^{241}Am (10^{-5} pCi/g dry)
Regional Background:							
Española/Santa Fe/Jemez	0.02 (0.60)[a]	16.0 (1.3)	4.9 (19.7)	295.3 (54.5)	17.3 (50.5)	79.8 (46.6)	79.8 (25.3)
RSRL[c]	0.36	77.9	39.8	469.3	64.6	449.6	130.4
Off-Site Perimeter:							
San Ildefonso	–0.08 (0.59)[b]	25.3 (2.7)	21.7 (25.8)	166.3 (45.2)	–207.5 (236.7)	–182.2 (308.6)	–6.7 (8.0)
Los Alamos Townsite	–0.13 (0.59)	12.0 (1.3)	0.0 (41.0)	188.9 (51.9)	–62.5 (157.0)	–75.8 (135.7)	58.5 (18.6)
White Rock/Pajarito Acres	–0.04 (0.60)	6.7 (1.3)	34.6 (20.0)	150.3 (47.9)	–20.0 (75.8)	263.3 (75.8)	12.0 (12.0)

[a] (±1 counting uncertainty); values are the uncertainty of the analytical results at the 65% confidence level.
[b] See Appendix B for an explanation of the presence of negative values.
[c] Regional Statistical Reference Level; this is the upper (95%) limit background concentration (mean + 2 std dev) for most radionuclides based on data from 1995 and 1999. The RSRL for ^{241}Am is based on present data.

Table 6-20. Total Recoverable Trace Elements (μg/g dry) in Wild Spinach Collected from Regional Background and Perimeter Areas during the 1999 Growing Season[a]

Location	Ag	As	Ba	Be	Cd	Cu	Hg	Ni	Pb	Sb	Se	Tl
Regional Background:												
Española/Santa Fe/Jemez	1.0[b]	0.25[b]	55.0	0.10[b]	0.50[b]	3.4	0.03[b]	1.0[b]	0.20[b]	0.20[b]	0.20[b]	0.20[b]
RSRL[c]	1.4	0.66	27.4	0.53	0.46		0.06	23.5	22.00	0.20	0.30	0.20
RSRL[d]	1.0	0.30	66.0	0.10	0.50	5.5	0.03	0.5	0.20	0.20	0.20	0.20
Off-Site Perimeter:												
San Ildefonso	1.0[b]	0.25[b]	54.0	0.10[b]	0.50[b]	3.1	0.03[b]	1.0[b]	2.2	0.20[b]	0.20[b]	0.20[b]
Los Alamos Townsite	1.0[b]	0.25[b]	15.0	0.10[b]	0.50[b]	4.5	0.03[b]	35.0	27.5	0.20[b]	0.20[b]	0.20[b]
White Rock/Pajarito Acres	1.0[b]	0.25[b]	25.0	0.10[b]	0.50[b]	5.8	0.03[b]	3.3	1.1	0.20[b]	0.20[b]	0.20[b]

[a] Analysis by EPA Method 3051 for total recoverable metals, and there were no statistical differences in any of the mean concentrations from perimeter and on-site locations as compared with regional background at the 0.05 probability level using a Wilcoxon Rank Sum Test.

[b] Less-than values were converted to one-half the concentration.

[c] Regional Statistical Reference Level; this is the upper (95%) limit background concentration (mean + 2 std dev) based on produce data from 1994 to 1996.

[d] Regional Statistical Reference Level; this is the upper (95%) limit background concentration (mean + 2 std dev) based on wild spinach data from 1999.

Table 6-21. Radionuclides in Honey Collected from Regional Background and Perimeter Locations during 1999

Radioisotope		Perimeter			Regional Background		
		Los Alamos	White Rock		Jemez		RSRL[d]
^{3}H	(pCi/mL)[a]	0.08 (0.67)[b]	2.26	(0.81)	0.17	(0.68)	5.25
^{137}Cs	(pCi/L)	[e]	10.0	(19.0)	0.0	(127.0)	305.28
^{238}Pu	(pCi/L)	[e]	–0.017	(0.019)[c]	0.049	(0.020)	0.07
^{239}Pu	(pCi/L)	[e]	0.058	(0.029)	0.027	(0.028)	0.12
^{241}Am	(pCi/L)	[e]	–0.023	(0.013)	–0.017	(0.009)	0.05
^{90}Sr	(pCi/L)	[e]	2.29	(3.01)	1.65	(3.33)	5.04
^{tot}U	(µg/L)	[e]	0.41	(0.04)	0.32	(0.03)	5.00

[a] pCi/mL of honey moisture; honey contains approximately 18% water and has a density of 1,860 g/L.
[b] (±1 counting uncertainty); values are the uncertainty of the analytical results at the 65% confidence level.
[c] See Appendix B for an explanation of the presence of negative values.
[d] Regional Statistical Reference Level; this is the upper (95%) limit background concentration (mean + 2 std dev) based on data from 1979 to 1995 (Fresquez et al., 1997a).
[e] Sample lost in analysis or not analyzed or outlier omitted.

Table 6-22. Radionuclides in Alfalfa Forage Collected from Regional Background and Perimeter Areas during the 1999 Growing Season

Location	^{3}H (pCi/mL)	^{tot}U (µg/g ash)	^{137}Cs (pCi/g ash)	^{90}Sr (pCi/g ash)	^{238}Pu (pCi/g ash)	^{239}Pu (pCi/g ash)	^{241}Am (pCi/g ash)
Regional Background:							
Española/Santa Fe/Jemez	–0.27 (0.58)[a,b]	1.61 (0.16)	0.00 (1.28)	1.25 (0.41)	–0.0025 (0.0055)	–0.0035 (0.0071)	–0.0021 (0.0018)
RSRL[c]	0.89	1.93	2.56	2.07	0.0085	0.0036	0.0015
Off-Site Perimeter:							
San Ildefonso	–0.03 (0.60)	1.47 (0.15)	–0.14 (0.20)	3.58 (0.51)	0.0024 (0.0026)	0.0036 (0.0031)	0.0025 (0.0010)
Los Alamos Townsite	0.10 (0.61)	0.39 (0.04)	0.26 (0.20)	0.68 (0.31)	0.0002 (0.0037)	0.0015 (0.0028)	0.0019 (0.0007)
White Rock/Pajarito Acres	–0.03 (0.60)	0.17 (0.02)	0.00 (1.53)	0.84 (0.30)	–0.0007 (0.0026)	0.0017 (0.0021)	–0.0021 (0.0018)

[a](±1 counting uncertainty); values are the uncertainty of the analytical results at the 65% confidence level.
[b]See Appendix B for an explanation of the presence of negative values.
[c]Regional Statistical Reference Level; this is the upper (95%) limit background concentration (mean + 2 std dev) based on present data.

Table 6-23. Total Recoverable Trace Elements (µg/g dry) in Alfalfa Forage Collected from Regional Background and Perimeter Areas during the 1999 Growing Season[a]

Location	Ag	As	Ba	Be	Cd	Cu	Hg	Ni	Pb	Sb	Se	Tl
Regional Background:												
Española/Santa Fe/Jemez	1.0[b]	0.25[b]	16.0	0.10[b]	0.50[b]	6.8	0.03[b]	1.0[b]	1.4	0.20[b]	0.20[b]	0.20[b]
RSRL[c]	1.4	0.66	27.4	0.53	0.46		0.06	23.5	22.00	0.20	0.30	0.20
RSRL[d]	1.0	0.30	19.2	0.10	0.50	8.8	0.03	1.0	2.2	0.20	0.20	0.20
Off-Site Perimeter:												
San Ildefonso	1.0[b]	0.25[b]	27.0	0.10[b]	0.50[b]	4.6	0.03[b]	1.0[b]	1.0	0.20[b]	0.20[b]	0.20[b]
Los Alamos Townsite	1.0[b]	0.25[b]	83.0	0.10[b]	0.50[b]	7.1	0.03[b]	1.0[b]	1.1	0.20[b]	0.50	0.20[b]
White Rock/Pajarito Acres	1.0[b]	0.25[b]	47.0	0.10[b]	0.50[b]	4.4	0.03[b]	1.0[b]	1.3	0.20[b]	0.20[b]	0.20[b]

[a] Analysis by EPA Method 3051 for total recoverable metals, and there were no statistical differences in any of the mean concentrations from perimeter and on-site locations as compared with regional background at the 0.05 probability level using a Wilcoxon Rank Sum Test.

[b] Less-than values were converted to one-half the concentration.

[c] Regional Statistical Reference Level; this is the upper (95%) limit background concentration (mean + 2 std dev) based on produce data from 1994 to 1996.

[d] Regional Statistical Reference Level; this is the upper (95%) limit background concentration (mean + 2 std dev) based on alfalfa data from 1999.

Table 6-24. Concentration of Radionuclides in Understory Plants Sampled from Within and Around Los Alamos National Laboratory during 1999

Location	^{tot}U (μg/g ash)	Uncertainty	^{90}Sr (pCi/g ash)	Uncertainty	^{137}Cs (pCi/g ash)	Uncertainty	^{238}Pu (pCi/g ash)	Uncertainty	$^{239,240}Pu$ (pCi/g ash)	Uncertainty	^{241}Am (pCi/g ash)	Uncertainty	^{3}H (pCi/L)	Uncertainty
Regional Background Stations:														
Embudo	0.4000	0.040	3.170	0.560	0.500	0.750	0.0033	0.0011	0.0054	0.0018	0.0060	0.0026	–310.0	620.0
Cochiti	0.1600	0.020	0.970	0.240	0.370	0.560	–0.0006	0.0011	0.0019	0.0015	0.0032	0.0014	60.0	650.0
Jemez	0.1600	0.020	2.100	0.360	–0.170	0.100	0.0004	0.0011	0.0009	0.0012	0.0032	0.0032	1110.0	720.0
Mean	0.2400	0.0267	2.0800	0.3867	0.2333	0.4700	0.0010	0.0011	0.0027	0.0015	0.0041	0.0024	286.667	663.33
Perimeter Stations:														
Otowi	0.1500	0.020	2.140	0.580	0.430	0.650	0.0047	0.0025	0.0988	0.0087	0.0042	0.0045	–130.0	630.0
TA-8 (GT-Site)	0.0500	0.010	1.660	0.460	0.450	0.680	–0.0020	0.0009	0.0025	0.0015	–0.0013	0.0028	140.0	650.0
Near TA-49 (BNP)	0.1000	0.010	3.500	0.660	0.370	0.550	0.0013	0.0016	0.0029	0.0015	0.0002	0.0027	150.0	650.0
East Airport	0.1700	0.020	3.600	0.880	0.380	0.570	0.0009	0.0014	0.0063	0.0022	0.0022	0.0025	–20.0	640.0
West Airport	0.1900	0.020	1.190	0.650	–0.300	0.110	0.0012	0.0012	0.0095	0.0025	–0.0036	0.0016	210.0	660.0
North Mesa	0.0500	0.010	15.390	4.680	0.130	0.200	0.0005	0.0010	0.0012	0.0013	–0.0012	0.0026	280.0	660.0
Sportsman's Club	0.3200	0.030	4.210	0.860	–0.130	0.110	0.0178	0.0094	0.0145	0.0098	0.0257	0.0086	380.0	670.0
Tsankawi/ PM-1	0.5400	0.050	2.410	0.290	0.220	0.320	0.0024	0.0013	0.0103	0.0023	0.0081	0.0035	180.0	660.0
White Rock (East)	0.7000	0.070	3.710	0.350	0.390	0.580	0.0017	0.0026	0.0035	0.0022	0.0084	0.0027	–300.0	620.0
San Ildefonso	0.3600	0.040	2.720	0.280	0.330	0.500	0.0044	0.0019	0.0063	0.0027	0.0069	0.0021	550.0	680.0
Mean	0.2630	0.0280	4.0530	0.9690	0.2270	0.4270	0.0033	0.0024	0.0156	0.0035	0.0050	0.0034	144.000	652.00
On-Site Stations:														
TA-16 (S-Site)	0.1000	0.010	1.820	0.340	1.060	1.580	–0.0005	0.0015	–0.0013	0.0017	0.0037	0.0039	10.0	700.0
TA-21 (DP-Site)	0.7300	0.070	1.120	0.280	0.360	0.540	0.0013	0.0018	0.0267	0.0042	0.0017	0.0060	580.0	730.0
Near TA-33	0.1400	0.010	1.760	0.490	1.110	1.670	–0.0007	0.0017	0.0050	0.0022	0.0084	0.0085	390.0	720.0
TA-50	0.3800	0.040	0.540	0.290	0.410	0.610	0.0034	0.0018	0.0045	0.0019	0.0050	0.0028	490.0	730.0
TA-51	0.2800	0.030	2.430	0.360	1.010	1.520	0.0006	0.0009	0.0041	0.0017	0.0086	0.0033	310.0	710.0
West of TA-53	0.4800	0.050	1.400	0.270	1.310	1.970	0.0000	0.0000	0.0052	0.0021	0.0017	0.0023	270.0	710.0
East of TA-53	0.1300	0.010	1.620	0.370	0.140	0.200	–0.0005	0.0045	0.0094	0.0056	0.0140	0.0128	130.0	700.0
East of TA-54	0.1400	0.010	2.360	0.480	0.250	0.370	0.0012	0.0024	0.0180	0.0041	0.0081	0.0068	1310.0	780.0
Portillo Drive/TA-36	0.0900	0.010	0.950	0.340	0.480	0.110	–0.0014	0.0028	0.0074	0.0039	0.0057	0.0083	780.0	740.0
Near Test Well DT-9	0.0400	0.010	1.150	0.380	0.380	0.560	0.0007	0.0033	0.0032	0.0034	0.0096	0.0116	1300.0	770.0
R-Site Road East	0.1500	0.020	1.390	0.410	0.180	0.270	0.0032	0.0033	0.0092	0.0036	0.0116	0.0114	210.0	710.0
Two-Mile Mesa	0.1400	0.010	0.990	0.370	0.280	0.420	0.0002	0.0023	0.0054	0.0033	0.0081	0.0076	230.0	710.0
Mean	0.233	0.023	1.461	0.365	0.581	0.818	0.001	0.002	0.008	0.003	0.007	0.007	501	726

Table 6-25. Concentration of Radionuclides in Overstory Plants Sampled from Within and Around Los Alamos National Laboratory during 1999

Location	^{tot}U (µg/g ash)	Uncertainty	^{90}Sr (pCi/g ash)	Uncertainty	^{137}Cs (pCi/g ash)	Uncertainty	^{238}Pu (pCi/g ash)	Uncertainty	$^{239,240}Pu$ (pCi/g ash)	Uncertainty	^{241}Am (pCi/g ash)	Uncertainty	^{3}H (pCi/L)	Uncertainty
Regional Background Stations:														
Embudo	0.52	0.05	2.1200	0.320	0.480	0.720	0.0009	0.0012	0.0023	0.0014	0.0023	0.0022	80	650
Cochiti	0.35	0.04	1.8300	0.300	0.520	0.780	–0.0003	0.0010	0.0024	0.0013	0.0069	0.0019	–70	640
Jemez	0.25	0.03	2.3000	0.340	0.170	0.260	0.0019	0.0015	0.0026	0.0016	0.0048	0.0020	–200	630
Mean	0.373	0.040	2.0833	0.320	0.390	0.5867	0.0008	0.0012	0.0024	0.0014	0.0047	0.0020	–63.3	640
Perimeter Stations:														
Otowi	0.23	0.02	4.5900	0.580	0.290	0.440	0.0000	0.0000	0.0076	0.0032	0.0054	0.0042	190	660
TA-8 (GT-Site)	0.14	0.01	0.2700	0.350	0.540	0.810	–0.0008	0.0016	0.0045	0.0026	–0.0031	0.0030	200	660
Near TA-49 (BNP)	0.25	0.03	0.9200	0.360	0.510	0.770	0.0020	0.0020	0.0078	0.0036	0.0107	0.0066	960	710
East Airport	0.36	0.04	3.1700	0.440	0.610	0.920	–0.0010	0.0010	0.0053	0.0020	0.0101	0.0044	240	660
West Airport	0.22	0.02	2.4700	0.450	0.440	0.660	0.0180	0.0039	0.0213	0.0040	0.0005	0.0040	300	660
North Mesa	0.16	0.02	2.5500	0.480	0.200	0.300	–0.0006	0.0012	0.0046	0.0025	0.0011	0.0032	130	650
Sportsman's Club	0.23	0.02	5.7500	1.050	1.240	1.860	0.0009	0.0013	0.0000	0.0000	0.0138	0.0056	190	660
Tsankawi/ PM-1	0.42	0.04	2.2800	0.250	0.690	1.040	0.0010	0.0012	0.0040	0.0016	0.0035	0.0034	190	660
White Rock (East)	0.50	0.05	2.0000	0.280	1.140	1.710	–0.0001	0.0017	0.0045	0.0030	0.0070	0.0031	410	670
San Ildefonso	0.56	0.06	2.4100	0.360	–0.36	0.100	–0.0004	0.0014	0.0224	0.0030	0.0175	0.0046	–10	640
Mean	0.493	0.050	2.230	0.297	0.490	0.9500	0.0002	0.0014	0.0103	0.0025	0.0093	0.0037	197	657
On-Site Stations:														
TA-16 (S-Site)	0.14	0.01	1.1600	0.470	2.370	3.560	0.0009	0.0034	0.0013	0.0040	0.0212	0.0084	90	700
TA-21 (DP-Site)	0.45	0.05	0.2700	0.320	1.800	2.710	0.0031	0.0022	0.0175	0.0039	0.0057	0.0041	60	700
Near TA-33	0.39	0.04	4.3800	0.470	0.930	1.390	–0.0004	0.0006	0.0056	0.0021	–0.0008	0.0030	280	710
TA-50	0.68	0.07	0.7500	0.270	1.060	1.600	0.0000	0.0000	0.0095	0.0031	0.0067	0.0066	370	720
TA-51	0.83	0.08	2.2300	0.340	0.470	0.710	0.0030	0.0021	0.0100	0.0027	0.0101	0.0061	80	700
West of TA-53	0.33	0.03	0.4400	0.470	1.410	2.120	0.0013	0.0024	0.0089	0.0039	0.0178	0.0081	950	750
East of TA-53	0.58	0.06	3.4700	0.340	8.320	12.480	0.0012	0.0011	0.0039	0.0017	0.0194	0.0051	170	710
East of TA-54	0.38	0.04	4.5000	0.540	0.300	0.460	0.0000	0.0000	0.0257	0.0068	0.0378	0.0158	1530	790
Portillo Drive/TA-36	0.49	0.05	2.6000	0.400	0.080	0.120	–0.0015	0.0032	0.0047	0.0034	–0.0019	0.0165	290	710
Near Test Well DT-9	0.20	0.02	2.6700	0.500	0.390	0.580	–0.0023	0.0046	0.0100	0.0063	0.0342	0.0157	250	710
R-Site Road East	0.11	0.01	0.5900	0.710	0.570	0.860	0.0024	0.0051	–0.001	0.0063	0.0066	0.0133	1180	770
Two-Mile Mesa	0.07	0.01	0.5600	0.590	0.370	0.550	–0.0028	0.0027	0.0035	0.0035	0.0145	0.0132	310	710
Mean	0.127	0.013	1.273	0.600	0.443	0.6633	–0.0009	0.0041	0.0043	0.0054	0.0184	0.0141	580	730

F. Figures

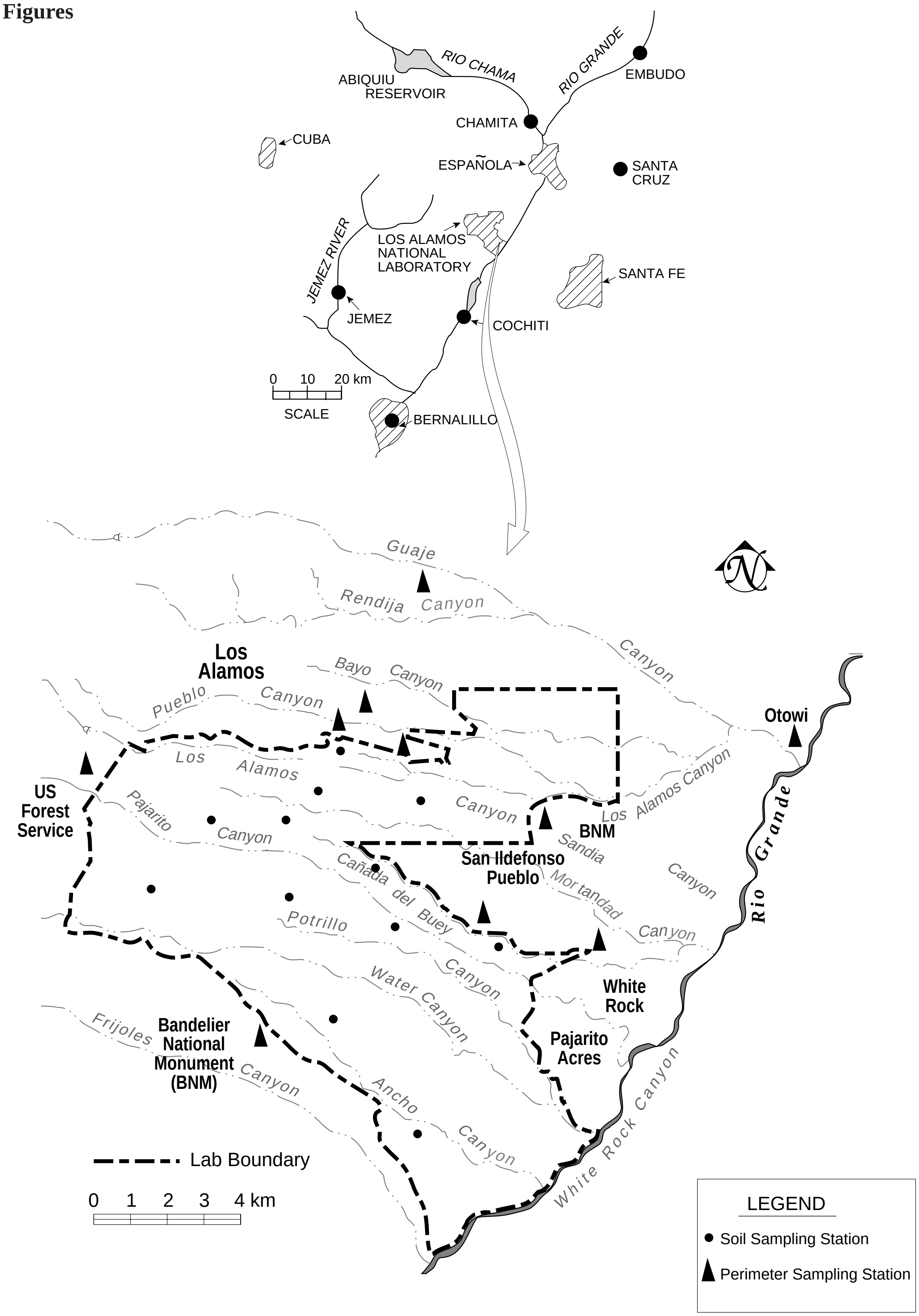

Figure 6-1. Off-site regional (top) and perimeter and on-site (bottom) Laboratory soil sampling locations.

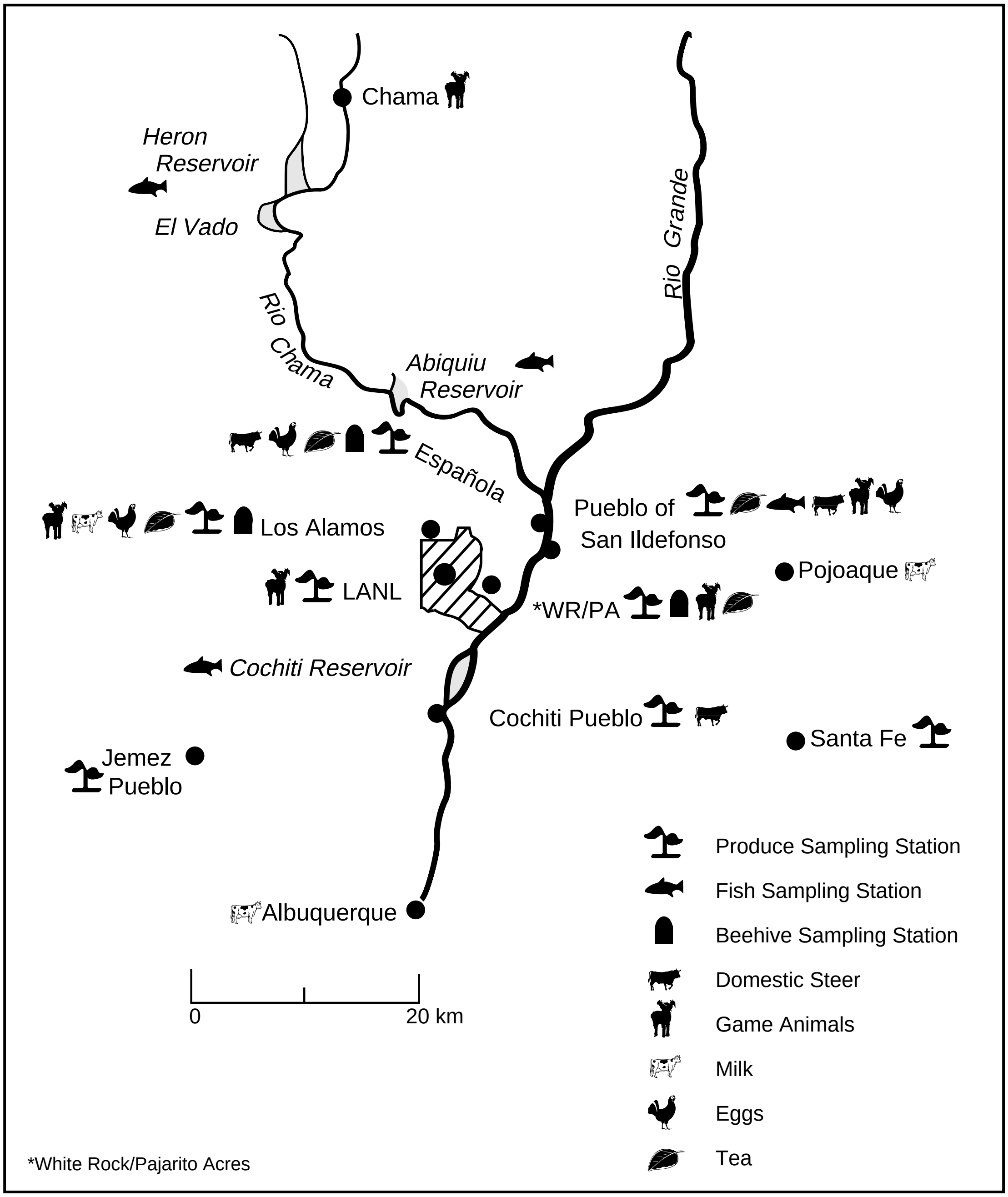

Figure 6-2. Produce, fish, milk, eggs, tea, domestic and game animals, and beehive sampling locations. (Map denotes general locations only.)

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Standards for Environmental Contaminants

Throughout this report, we compare concentrations of radioactive and chemical constituents in air and water samples with pertinent standards and guidelines in regulations of federal and state agencies. No comparable standards for soils, sediments, or foodstuffs are available. Los Alamos National Laboratory (LANL or the Laboratory) operations are conducted in accordance with directives for compliance with environmental standards. These directives are contained in Department of Energy (DOE) Orders 5400.1, "General Environmental Program;" 5400.5, "Radiation Protection of the Public and the Environment;" 5480.1, "Environmental Protection, Safety, and Health Protection Standards;" 5480.11, "Requirements for Radiation Protection for Occupational Workers;" 5484.1, "Environmental Radiation Protection, Safety, and Health Protection Information Reporting Requirements," Chap. III, "Effluent and Environmental Monitoring Program Requirements," and 231.1, "Environmental Safety and Health Reporting."

Radiation Standards. DOE regulates radiation exposure to the public and the worker by limiting the radiation dose that can be received during routine Laboratory operations. Because some radionuclides remain in the body and result in exposure long after intake, DOE requires consideration of the dose commitment caused by inhalation, ingestion, or absorption of such radionuclides. This evaluation involves integrating the dose received from radionuclides over a standard period of time. For this report, 50-yr dose commitments were calculated using the DOE dose factors from DOE 1988a and DOE 1988b. The dose factors DOE adopted are based on the recommendations of Publication 30 of the International Commission on Radiological Protection (ICRP 1988).

In 1990, DOE issued Order 5400.5, which finalized the interim radiation protection standard (RPS) for the public (NCRP 1987). Table A-1 lists currently applicable RPSs, now referred to as public dose limits (PDLs), for operations at the Laboratory. DOE's comprehensive PDL for radiation exposure limits the effective dose equivalent (EDE) that a member of the public can receive from DOE operations to 100 mrem per year. The PDLs and the DOE dose factors are based on recommendations in ICRP (1988) and the National Council on Radiation Protection and Measurements (NCRP 1987).

The EDE is the hypothetical whole-body dose that would result in the same risk of radiation-induced cancer or genetic disorder as a given exposure to an individual organ. It is the sum of the individual organ doses, weighted to account for the sensitivity of each organ to radiation-induced damage. The weighting factors are taken from the recommendations of the ICRP. The EDE includes doses from both internal and external exposure.

Radionuclide concentrations in air or water are compared to DOE's Derived Concentration Guides (DCGs) to evaluate potential impacts to members of the public. The DCGs for air are the radionuclide concentrations in air that, if inhaled continuously for an entire year, would give a dose of 100 mrem. Similarly, the DCGs for water are those concentrations in water that if consumed at a maximum rate of 730 liters per year, would give a dose of 100 mrem per year. Derived air concentrations (DACs) were developed for protection of workers and are the air concentrations that, if inhaled throughout a "work year," would give the limiting allowed dose to the worker. Table A-2 shows the DCGs and DACs.

In addition to DOE standards, in 1985 and 1989, the EPA established the National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities, 40 CFR 61, Subpart H. This regulation states that emissions of radionuclides to the ambient air from Department of Energy facilities shall not exceed those amounts that would cause any member of the public to receive in any year an effective dose equivalent of 10 mrem/yr. DOE has adopted this dose limit (Table A-1). This dose is calculated at the location of a residence, school, business or office. In addition, the regulation requires monitoring of all release points that can produce a dose of 0.1 mrem to a member of the public. A complete listing a 40 CFR 61 Subpart H is available in ESH-17 2000.

Nonradioactive Air Quality Standards. Table A-3 shows Federal and state ambient air quality standards for nonradioactive pollutants.

National Pollutant Discharge Elimination System. Table A-4 presents a summary of the outfalls, the types of monitoring required under National Pollutant Discharge Elimination System (NPDES), and the limits established for sanitary and industrial outfalls. Table A-5 presents NPDES annual water quality parameters for all outfalls.

Drinking Water Standards. For chemical constituents in drinking water, regulations and standards are issued by the Environmental Protection Agency (EPA) and adopted by the New Mexico Environment Department (NMED) as part of the New Mexico Drinking Water Regulations (Table A-6) (NMEIB 1995). EPA's secondary drinking water standards, which are not included in the New Mexico Drinking Water Regulations and are not enforceable, relate to contaminants in drinking water that primarily affect aesthetic qualities associated with public acceptance of drinking water (EPA 1989b). There may be health effects associated with considerably higher concentrations of these contaminants.

Radioactivity in drinking water is regulated by EPA regulations contained in 40 CFR 141 (EPA 1989b) and New Mexico Drinking Water Regulations, Sections 206 and 207 (NMEIB 1995). These regulations provide that combined radium-226 and radium-228 may not exceed 5 pCi per liter. Gross alpha activity (including radium-226, but excluding radon and uranium) may not exceed 15 pCi per liter.

A screening level of 5 pCi per liter for gross alpha is established to determine when analysis specifically for radium isotopes is necessary. In this report, plutonium concentrations are compared with both the EPA gross alpha standard for drinking water (Table A-6) and the DOE guides calculated for the DCGs applicable to drinking water (Table A-2).

For man-made beta- and photon-emitting radionuclides, EPA drinking water standards are limited to concentrations that would result in doses not exceeding 4 mrem per year, calculated according to a specified procedure. In addition, DOE Order 5400.5 requires that persons consuming water from DOE-operated public water supplies do not receive an EDE greater than 4 mrem per year. DCGs for drinking water systems based on this requirement are in Table A-2.

Surface Water Standards. Concentrations of radionuclides in surface water samples may be compared to either the DOE DCGs (Table A-2) or the New Mexico Water Quality Control Commission (NMWQCC) stream standard, which references the state's radiation protection regulations. However, New Mexico radiation levels are in general two orders of magnitude greater than DOE's DCGs for public dose, so only the DCGs will be discussed here. The concentrations of nonradioactive constituents may be compared with the NMWQCC Livestock Watering and Wildlife Habitat stream standards (NMWQCC 1995). (See Tables A-7 and A-8.) The NMWQCC groundwater standards can also be applied in cases where discharges may affect groundwater.

Organic Analysis of Surface and Groundwaters: Methods and Analytes. Organic analyses of surface waters, groundwaters, and sediments are made using SW-846 methods as shown in Table A-9. This table shows the number of analytes included in each analytical suite. The specific compounds analyzed in each suite are listed in Tables A-10 through A-13.

Table A-1. Department of Energy Public Dose Limits for External and Internal Exposures

	Effective Dose Equivalent[a] at Point of Maximum Probable Exposure
Exposure of Any Member of the Public[b]	
All Pathways	100 mrem/yr[c]
Air Pathway Only[d]	10 mrem/yr
Drinking Water	4 mrem/yr
Occupational Exposure[b]	
Stochastic Effects	5 rem (annual EDE[e])
Nonstochastic Effects	
Lens of eye	15 rem (annual EDE[e])
Extremity	50 rem (annual EDE[e])
Skin of the whole body	50 rem (annual EDE[e])
Organ or tissue	50 rem (annual EDE[e])
Unborn Child	
Entire gestation period	0.5 rem (annual EDE[e])

[a] As used by DOE, effective dose equivalent (EDE) includes both the EDE from external radiation and the committed EDE to individual tissues from ingestion and inhalation during the calendar year.

[b] In keeping with DOE policy, exposures must be limited to as small a fraction of the respective annual dose limits as practicable. DOE's public dose limit (PDL) applies to exposures from routine Laboratory operation, excluding contributions from cosmic, terrestrial, and global fallout; self-irradiation; and medical diagnostic sources of radiation. Routine operation means normal, planned operation and does not include actual or potential accidental or unplanned releases. Exposure limits for any member of the general public are taken from DOE Order 5400.5 (DOE 1990). Limits for occupational exposure are taken from 10 CFR 835, Occupational Radiation Protection.

[c] Under special circumstances and subject to approval by DOE, this limit on the EDE may be temporarily increased to 500 mrem/yr, provided the dose averaged over a lifetime does not exceed the principal limit of 100 mrem per year.

[d] This level is from EPA's regulations issued under the Clean Air Act, (40 CFR 61, Subpart H) (EPA 1989a).

[e] Annual EDE is the EDE received in a year.

Table A-2. Department of Energy's Derived Concentration Guides for Water and Derived Air Concentrations[a]

Nuclide	f_1[b]	DCGs for Water Ingestion in Uncontrolled Areas (pCi/L)	DCGs for Drinking Water Systems (pCi/L)	DCGs for Air Inhalation by the Public (μCi/mL)	Class[b]	DACs for Occupational Exposure (μCi/mL)
^{3}H	—	2,000,000	80,000	1×10^{-7}[c]	—	2×10^{-5}[c]
^{7}Be	5×10^{-3}	1,000,000	40,000	4×10^{-8}	Y	8×10^{-6}
^{89}Sr	2×10^{-5}	20,000	800	3×10^{-10}	Y	6×10^{-8}
^{90}Sr[b]	1×10^{-6}	1,000	40	9×10^{-12}	Y	2×10^{-9}
^{137}Cs	1×10^{0}	3,000	120	4×10^{-10}	D	7×10^{-8}
^{234}U	5×10^{-2}	500	20	9×10^{-14}	Y	2×10^{-11}
^{235}U	5×10^{-2}	600	24	1×10^{-13}	Y	2×10^{-11}
^{238}U	5×10^{-2}	600	24	1×10^{-13}	Y	2×10^{-11}
^{238}Pu	1×10^{-3}	40	1.6	3×10^{-14}	W	3×10^{-12}
^{239}Pu[b]	1×10^{-3}	30	1.2	2×10^{-14}	W	2×10^{-12}
^{240}Pu	1×10^{-3}	30	1.2	2×10^{-14}	W	2×10^{-12}
^{241}Am	1×10^{-3}	30	1.2	2×10^{-14}	W	2×10^{-12}

[a]Guides for uncontrolled areas are based on DOE's public dose limit for the general public (DOE 1990); those for occupational exposure are based on radiation protection standards in 10 CFR 835. Guides apply to concentrations in excess of those occurring naturally or that are due to worldwide fallout.
[b]Gastrointestinal tract absorption factors (f_1) and lung retention classes (Class) are taken from ICRP30 (ICRP 1988). Codes: Y = year, D = day, W = week.
[c]Tritium in the HTO form.

Table A-3. National (40 CFR 50) and New Mexico (20 NMAC 2.3) Ambient Air Quality Standards

Pollutant	Averaging Time	Unit	New Mexico Standard	Federal Standards Primary	Federal Standards Secondary
Sulfur dioxide	Annual	ppm	0.02	0.030[a]	
	24 hours	ppm	0.10	0.14[b]	
	3 hours	ppm			0.5[b]
Hydrogen sulfide	1 hour	ppm	0.010[b]		
Total reduced sulfur	1/2 hour	ppm	0.003[b]		
Total Suspended Particulates	Annual	$\mu g/m^3$	60	50	50
	30 days	$\mu g/m^3$	90		
	7 days	$\mu g/m^3$	110		
	24 hours	$\mu g/m^3$	150		
PM_{10}[c]	Annual	$\mu g/m^3$		50	50
	24 days	$\mu g/m^3$		150	150
$PM_{2.5}$[d]	Annual	$\mu g/m^3$		15[e]	15[e]
	24 hours	$\mu g/m^3$		65[e]	65[e]
Carbon monoxide	8 hours	ppm	8.7	9[b]	
	1 hour	ppm	13.1	35[b]	
Ozone[f]	1 hour	ppm		0.12	0.12
	8 hours	ppm		0.08	0.08
Nitrogen dioxide	Annual	ppm	0.05	0.053	0.053
	24 hours	ppm	0.10		
Lead and lead compounds	Calendar quarter	$\mu g/m^3$		1.5	1.5

[a] Not to be exceeded in a calendar year.
[b] Not to be exceeded more than once in a calendar year.
[c] Particles ≤10 µm in diameter.
[d] Particles ≤2.5 µm in diameter.
[e] Applicable when the changes to the NM State Implementation Plan are approved by EPA.
[f] As the result of a May 14, 1999, court ruling, EPA does not have the authority to implement the eight-hour ozone standard. Currently, LANL must meet the one-hour ozone standard. EPA has appealed the court decision.

Table A-4. Limits Established by National Pollutant Discharge Elimination System Permit No. NM0028355 for Sanitary and Industrial Outfall Discharges for 1999

Discharge Category	Permit Parameter		Daily Average		Daily Maximum	
Sanitary						
13S TA-46 SWS Facility	BOD[a]	concentration	30	mg/L	45	mg/L
		loading limit	100	lb/day	N/A[b]	
	TSS[c]	concentration	30	mg/L	45	mg/L
		loading limit	100	lb/day	N/A	
	Fecal coliform bacteria[d]		500	colonies/100 mL	500	colonies/100 mL
	pH		6.0–9.0 s.u.		6.0–9.0 s.u.	
	Flow[e]		Report		Report	

Discharge Category	Number of Outfalls	Sampling Frequency	Permit Parameter	Daily Average	Daily Maximum	Unit of Measurement
Industrial						
001 Power Plant	1	Monthly	TSS	30	100	mg/L
			Free available CL_2	0.2	0.5	mg/L
			pH	6.0–9.0	6.0–9.0	s.u.
02A Boiler Blowdown	1	Every 3 months	TSS	30	100	mg/L
			Total Fe	10	40	mg/L
			Total Cu	1.0	1.0	mg/L
			Total P	20	40	mg/L
			Sulfite	35	70	mg/L
			Total Cr	1.0	1.0	mg/L
			pH	6.0–9.0	6.0–9.0	s.u.
03A Treated Cooling Water	16	Every 3 months	TSS	30	100	mg/L
			Free available Cl	0.2	0.5	mg/L
			Total P	20	40	mg/L
			Total As	0.04	0.04	mg/L
			pH	6.0–9.0	6.0–9.0	s.u.
04A Noncontact Cooling Water	13	Every 3 months	pH	6.0–9.0	6.0–9.0	s.u.
			Total residual CL_2	Report[f]	Report	mg/L
051 Radioactive Liquid Waste Treatment Facility (TA-50)	1	Variable: weekly to monthly	COD[g]	94	156	lb/day
			TSS	18.8	62.6	lb/day
			Total Cd	0.06	0.30	lb/day
			Total Cr	0.19	0.38	lb/day
			Total Cu	0.63	0.63	lb/day
			Total Fe	1.0	2.0	lb/day
			Total Pb	0.06	0.15	lb/day
			Total Hg	0.003	0.09	lb/day
			Total Zn	0.62	1.83	lb/day
			TTO[h]	1.0	1.0	mg/L
			Total Ni[f]	Report	Report	mg/L
			Total N[f]	Report	Report	mg/L
			Nitrate-Nitrate as N[f]	Report	Report	mg/L
			Ammonia (as N)[f]	Report	Report	mg/L

Table A-4. (Cont.)

Discharge Category	Number of Outfalls	Sampling Frequency	Permit Parameter	Daily Average	Daily Maximum	Unit of Measurement
051 (Cont.)			pH	6.0–9.0	6.0–9.0	s.u.
			COD	125	125	mg/L
			Total Cd	0.2	0.2	mg/L
			Total Cr	5.1	5.1	mg/L
			Total Cu	1.6	1.6	mg/L
			Total Pb	0.4	0.4	mg/L
			Total Zn	95.4	95.4	mg/L
			^{226}Ra and ^{228}Ra	30.0	30.0	pCi/L
05A High Explosive Wastewater	2	Every 3 months	Oil & Grease	15	15	mg/L
			COD	125	125	mg/L
			TSS	30.0	45.0	mg/L
			pH	6.0–9.0	6.0–9.0	s.u.
06A Photo Wastewater	1	Every 3 months	Total Ag	0.5	1.0	mg/L
			pH	6.0–9.0	6.0–9.0	s.u.

[a]Biochemical oxygen demand.
[b]Not applicable.
[c]Total suspended solids.
[d]Logarithmic mean.
[e]Discharge volumes are reported to EPA but are not subject to limits.
[f]Concentrations are reported to EPA but are not subject to limits.
[g]Chemical oxygen demand.
[h]Total toxic organics.
Note: Sampling frequency for sanitary outfall varies from once a week to once every three months, depending on the parameter.

Table A-5. Annual Water Quality Parameters Established by National Pollutant Discharge Elimination System Permit No. NM0028355 for Sanitary and Industrial Outfall Discharges for 1999

Discharge Category	Number of Outfalls	Sampling Frequency	Permit Parameter	Daily Average	Daily Maximum	Unit of Measurement
All Outfall Categories: Annual Water Quality Parameters	36	Annually	Total Al	5.0	5.0	mg/L
			Total As	0.04	0.04	mg/L
			Total B	5.0	5.0	mg/L
			Total Cd	0.2	0.2	mg/L
			Total Cr	5.1	5.1	mg/L
			Total Co	1.0	1.0	mg/L
			Total Cu	1.6	1.6	mg/L
			Total Pb	0.4	0.4	mg/L
			Total Hg	0.01	0.01	mg/L
			Total Se	0.05	0.05	mg/L
			Total V	0.1	0.1	mg/L
			Total Zn	95.4	95.4	mg/L
			^{226}Ra and ^{228}Ra	30.0	30.0	pCi/L
			^{3}H[a]	3,000,000	3,000,000	pCi/L

[a]When accelerator produced.

Table A-6. Safe Drinking Water Act Maximum Contaminant Levels in the Water Supply for Radiochemicals, Inorganic Chemicals, and Microbiological Constituents

Contaminants	Level
Radiochemical:	**Maximum Contaminant Level**
Gross alpha	15 pCi/L[a]
Gross beta & photon	4 mrem/yr[a]
^{226}Ra & ^{228}Ra	5 pCi/L[a]
U	20 µg/L[a]
Radon	300 pCi/L[b]
	Screening Level
Gross alpha	5 pCi/L[a]
Gross beta	50 pCi/L[a]
Inorganic Chemical:	
Primary Standards	**Maximum Contaminant Level (mg/L)**
Asbestos	7 million fibers/L (longer than 10 µm)
As	0.05[a]
Ba	2
Be	0.004
Cd	0.005
CN	0.2
Cr	0.1
F	4
Hg	0.002
Ni	0.1
NO_3 (as N)	10
NO_2 (as N)	1
SO_4	500[c]
Se	0.05
Sb	0.006
Tl	0.002
	Action Levels (mg/L)
Pb	0.015
Cu	1.3
Secondary Standards	**(mg/L)**
Cl	250
Cu	1
Fe	0.3
Mn	0.05
Zn	5
Total Dissolved Solids	500
pH	6.5–8.5
Microbiological:	**Maximum Contaminant Level**
Presence of total coliforms	5% of samples/month
Presence of fecal coliforms or Escherichia coli	No coliform-positive repeat samples following a fecal coliform-positive sample

[a]Proposed.
[b]The proposed MCL for radon was withdrawn by the EPA on August 6, 1996.
[c]The proposed MCL for sulfate was suspended by the EPA on August 6, 1996.

Table A-7. Livestock Watering Standards[a]

Livestock Contaminant	Concentration	
Dissolved Al	5	mg/L
Dissolved As	0.2	mg/L
Dissolved B	5	mg/L
Dissolved Cd	0.05	mg/L
Dissolved Cr	1	mg/L
Dissolved Co	1	mg/L
Dissolved Cu	0.5	mg/L
Dissolved Pb	0.1	mg/L
Total Hg	0.01	mg/L
Dissolved Se	0.05	mg/L
Dissolved V	0.1	mg/L
Dissolved Zn	25	mg/L
^{226}Ra and ^{228}Ra	30	pCi/L
^{3}H	20,000	pCi/L
Gross alpha	15	pCi/L

[a]NMWQCC 1995.

Table A-8. Wildlife Habitat Stream Standards[a]

The following narrative standard shall apply:

1. Except as provided below in Paragraph 2 of this section, no discharge shall contain any substance, including, but not limited to selenium, DDT, PCBs, and dioxin, at a level which, when added to background concentrations, can lead to bioaccumulation to toxic levels in any animal species. In the absence of site-specific information, this requirement shall be interpreted as establishing a stream standard of 2 µg per liter for total recoverable selenium and of 0.012 µg per liter for total mercury.

2. The discharge of substances that bioaccumulate in excess of levels specified above in Paragraph 1 is allowed if, and only to the extent that, the substances are present in the intake waters which are diverted and utilized prior to discharge, and then only if the discharger utilizes best available treatment technology to reduce the amount of bioaccumulating substances which are discharged.

3. Discharges to waters which are designated for wildlife habitat uses, but not for fisheries uses, shall not contain levels of ammonia or chlorine in amounts which reduce biological productivity and/or species diversity to levels below those which occur naturally and in no case shall contain chlorine in excess of 1 mg per liter nor ammonia in excess of levels that can be accomplished through best reasonable operating practices at existing treatment facilities.

4. A discharge which contains any heavy metal at concentrations in excess of the concentrations set forth in Section 3101.J.1 of these standards shall not be permitted in an amount, measured by total mass, which exceeds by more than 5% the amount present in the intake waters which are diverted and utilized prior to the discharge, unless the discharger has taken steps (an approved program to require industrial pretreatment or a corrosion program) appropriate to reduce influent concentration to the extent practicable.

[a]NMWQCC 1995.

Table A-9. Organic Analytical Methods

Test	SW-846 Method	Extraction Water	Extraction Sediments	Number of Analytes
Volatiles	8260A	E0730	E0720	59
Semivolatiles	8270B[a]	E0530	E0510	69
PCB[b]	8080A, 8081	E0430	E0410	4
HE[c]	8330			14

[a] Direct injection used for method 8270B.
[b] Polychlorinated biphenyls.
[c] High explosives.

Table A-10. Volatile Organic Compounds

Analytes	Limit of Quantitation Water (μg/L)
Acetone	20
Benzene	5
Bromobenzene	5
Bromochloromethane	5
Bromodichloromethane	5
Bromoform	5
Bromomethane	10
Butanone [2-]	20
Butylbenzene [n-]	5
Butylbenzene [sec-]	5
Butylbenzene [tert-]	5
Carbon disulfide	5
Carbon tetrachloride	5
Chlorobenzene	5
Chlorodibromomethane	5
Chloroethane	10
Chloroform	5
Chloromethane	10
Chlorotoluene [o-]	5
Chlorotoluene [p-]	5
Dibromo-3-chloropropane [1,2]	10
Dibromoethane [1,2-]	5
Dibromomethane	5
Dichlorobenzene [m-] (1,3)	5
Dichlorobenzene [o-] (1,2)	5
Dichlorobenzene [p-] (1,4)	5
Dichlorodifluoromethane	10
Dichloroethane [1,1-]	5
Dichloroethane [1,2-]	5

Table A-10. Volatile Organic Compounds (Cont.)

Analytes	Limit of Quantitation Water (μg/L)
Dichloroethene [1,1-]	5
Dichloroethene [trans-1,2-]	5
Dichloropropane [1,2-]	5
Dichloropropane [1,3-]	5
Dichloropropane [2,2-]	5
Dichloropropene [1,1-]	5
Dichloropropene [cis-1,3-]	5
Dichloropropene [trans-1,3-]	5
Ethylbenzene	5
Hexachlorobutadiene	10
Hexanone [2-]	20
Isopropylbenzene	5
Isopropyltoluene [4-]	5
Methyl iodide	5
Methyl-2-pentanone [4-]	20
Methylene chloride	5
Naphthalene	10
Propylbenzene	5
Styrene	5
Tetrachloroethane [1,1,1,2-]	5
Tetrachloroethane [1,1,2,2-]	5
Tetrachloroethylene	5
Toluene	5
Trichloro-1,2,2-trifloroethane [1,1,2-]	5
Trichlorobutadiene [1,2,3-]	10
Trichlorobutadiene [1,2,4-]	10
Trichloroethane [1,1,1-]	5
Trichloroethane [1,1,2-]	5
Trichloroethene	5
Trichlorofluoromethane	5
Trichloropropane [1,2,3-]	5
Trimethylbenzene [1,2,4-]	5
Trimethylbenzene [1,3,5-]	5
Vinyl chloride	10
Xylene (o)	5
Xylene (x+p)	5
Xylenes (o + m + p) [Mixed-]	5

Table A-11. Semivolatile Organic Compounds

	Limit of Quantitation	
Analytes	**Water (μg/L)**	**Sediments (mg/kg-avg)**
Acenaphthene	10	0.38
Acenaphthylene	10	0.38
Aniline	10	0.38
Anthracene	10	0.38
Azobenzene	10	0.38
Benzidine [m-]	50	1.95
Benzo[a]anthracene	10	0.38
Benzo[a]pyrene	10	0.38
Benzo[b]fluoranthene	10	0.38
Benzo[g,h,i]perylene	10	0.38
Benzo[k]fluoranthene	10	0.38
Benzoic acid	50	1.95
Benzyl alcohol	10	0.38
Bis(2-chloroethoxy)methane	10	0.38
Bis(2-chloroethyl)ether	10	0.38
Bis(2-chloroisopropyl)ether	10	0.38
Bis(2-ethylhexyl)phthalate	10	0.38
Bromophenylphenyl ether [4-]	10	0.38
Butyl benzyl phthalate	10	0.38
Chloro-3-methylphenol [4-]	10	0.38
Chloroaniline [4-]	10	0.38
Chloronaphthalene [2-]	10	0.38
Chlorophenol [o-]	10	0.38
Chlorophenylphenyl ether [4-]	10	0.38
Chrysene	10	0.38
Di-n-butyl phthalate	10	0.38
Di-n-octyl phthalate	10	0.38
Dibenzo[a,h]anthracene	10	0.38
Dibenzofuran	10	0.38
Dichlorobenzene (1,2) [o-]	10	0.38
Dichlorobenzene (1,3) [m-]	10	0.38
Dichlorobenzene (1,4) [p-]	10	0.38
Dichlorobenzidine [3,3'-]	20	0.66
Dichlorophenol [2,4-]	10	0.38
Diethyl phthalate	10	0.38
Dimethyl phthalate	10	0.38
Dimethylphenol [2,4-]	10	0.38
Dinitrophenol [2,4-]	50	1.95
Dinitrotoluene [2,4-]	10	0.38
Dinitrotoluene [2,6-]	10	0.38
Fluoranthene	10	0.38
Fluorene	10	0.38
Hexachlorobenzene	10	0.38
Hexachlorobutadiene	50	1.95

Table A-11. Semivolatile Organic Compounds (Cont.)

	Limit of Quantitation	
Analytes	**Water (μg/L)**	**Sediments (mg/kg-avg)**
Hexachlorocyclopentadiene	10	0.38
Hexachloroethane	10	0.38
Indeno[1,2,3-cd]pyrene	10	0.38
Isophorone	10	0.38
Methyl-4,6-dinitrophenol [2-]	50	1.95
Methylnaphthalene [2-]	10	0.38
Methylphenol [2-]	10	0.38
Methylphenol [4-]	10	0.38
Naphthalene	10	0.38
Nitroaniline [2-]	20	0.66
Nitroaniline [3-]	20	0.66
Nitroaniline [4-]	20	0.66
Nitrobenzene	10	0.38
Nitrophenol [2-]	10	0.38
Nitrophenol [4-]	50	1.95
Nitrosodi-n-propylamine [N-]	10	0.38
Nitrosodimethylamine [N-]	10	0.38
Nitrosodiphenylamine [N-]	10	0.38
Pentachlorophenol	50	1.95
Phenanthrene	10	0.38
Phenol	10	0.38
Picoline [2-]	10	0.38
Pyrene	10	1.95
Pyridine	10	0.38
Trichlorobenzene [1,2,4-]	10	0.38
Trichlorophenol [2,4,5-]	10	0.38
Trichlorophenol [2,4,6-]	10	0.38

Table A-12. Polychlorinated Biphenyls

	Detection Limits	
Analytes	**Water (μg/L)**	**Sediments (mg/kg)**
Aroclor 1016	0.5	0.25
Aroclor 1221	0.5	0.25
Aroclor 1232	0.5	0.25
Aroclor 1242	0.5	0.25
Aroclor 1248	0.5	0.25
Aroclor 1254	0.5	0.25
Aroclor 1260	0.5	0.25
Aroclor 1262	0.5	0.25

Table A-13. High-Explosives Analytes

	Limit of Quantitation	
Analytes	**Water (μg/L**	**Sediments (mg/kg)**
HMX	0.5	0.5
RDX	0.5	0.5
1,3,5-TNB	0.5	0.5
1,3-DNB	0.5	0.5
Tetryl	0.5	0.5
Nitrobenzene	0.5	0.5
2,4,6-TNT	0.5	0.5
4-A-2,6-DNT	0.5	0.5
2,6-DNT	0.5	0.5
2,4-DNT	0.5	0.5
2-NT	0.5	0.5
4-NT	0.5	0.5
3-NT	0.5	0.5

References

DOE 1988a: US Department of Energy, “Internal Dose Conversion Factors for Calculation of Dose to the Public,” US Department of Energy report DOE/EH-0071 (July 1988).

DOE 1988b: US Department of Energy, “External Dose-Rate Conversion Factors for Calculation of Dose to the Public,” US Department of Energy report DOE/EH-0070 (July 1988).

DOE 1990: US Department of Energy, “Radiation Protection of the Public and the Environment,” US Department of Energy Order 5400.5 (February 8, 1990).

EPA 1989a: US Environmental Protection Agency, “40CFR 61, National Emission Standards for Hazardous Air Pollutants, Radionuclides; Final Rule and Notice of Reconsideration,” Federal Register 54, 51 653-51 715 (December 15, 1989).

EPA 1989b: US Environmental Protection Agency, “National Interim Primary Drinking Water Regulations,” Code of Federal Regulations, Title 40, Parts 141 and 142 (1989), and “National Secondary Drinking Water Regulations,” Part 143 (1989).

ESH-17 2000: Air Quality Group, “Quality Assurance Project Plan for the Rad-NESHAP Compliance Project,” Air Quality Group Document ESH-17-RN, R1 (January 2000).

ICRP 1988: International Commission on Radiological Protection, “Limits for Intakes of Radionuclides by Workers,” ICRP Publication 30, Parts 1, 2, and 3, and their supplements, Annals of the ICRP 2(3/4) -8(4) (1979-1982), and Publication 30, Part 4, 19(4) (1988).

NCRP 1987: National Council on Radiation Protection and Measurements, “Recommendations on Limits for Exposure to Ionizing Radiation,” NCRP report No. 91 (June 1987).

NMEIB 1995: New Mexico Environmental Improvement Board, “New Mexico Drinking Water Regulations,” (as amended through January 1995).

NMWQCC 1995: New Mexico Water Quality Control Commission, “State of New Mexico Water Quality Standards for Interstate and Intrastate Streams,” Section 3-101.K (as amended through January 23, 1995).

Units of Measurement

Throughout this report the International System of Units (SI) or metric system of measurements has been used, with some exceptions. For units of radiation activity, exposure, and dose, US Customary Units (that is, curie [Ci], roentgen [R], rad, and rem) are retained as the primary measurement because current standards are written in terms of these units. The equivalent SI units are the becquerel (Bq), coulomb per kilogram (C/kg), gray (Gy), and sievert (Sv), respectively.

Table B-1 presents prefixes used in this report to define fractions or multiples of the base units of measurements. Scientific notation is used in this report to express very large or very small numbers. Translating from scientific notation to a more traditional number requires moving the decimal point either left or right from the number. If the value given is 2.0×10^3, the decimal point should be moved three numbers (insert zeros if no numbers are given) to the **right** of its present location. The number would then read 2,000. If the value given is 2.0×10^{-5}, the decimal point should be moved five numbers to the **left** of its present location. The result would be 0.00002.

Table B-2 presents conversion factors for converting SI units into US Customary Units. Table B-3 presents abbreviations for common measurements.

Data Handling of Radiochemical Samples

Measurements of radiochemical samples require that analytical or instrumental backgrounds be subtracted to obtain net values. Thus, net values are sometimes obtained that are lower than the minimum detection limit of the analytical technique. Consequently, individual measurements can result in values of positive or negative numbers. Although a negative value does not represent a physical reality, a valid long-term average of many measurements can be obtained only if the very small and negative values are included in the population calculations (Gilbert 1975).

For individual measurements, uncertainties are reported as one standard deviation. The standard deviation is estimated from the propagated sources of analytical error.

Standard deviations for the station and group (off-site regional, off-site perimeter, and on-site) means are calculated using the following equation:

$$s = \sqrt{\frac{\sum_{i=1}^{N} \left(\bar{c} - c_i\right)^2}{(N-1)}},$$

where

c_i = sample i,

$\bar{c}$ = mean of samples from a given station or group, and

N = number of samples comprising a station or group.

This value is reported as one standard deviation (1*s*) for the station and group means.

Tables

Table B-1. Prefixes Used with SI (Metric) Units

Prefix	Factor	Symbol
mega	1 000 000 or 10^6	M
kilo	1 000 or 10^3	k
centi	0.01 or 10^{-2}	c
milli	0.001 or 10–3	m
micro	0.000001 or 10^{-6}	µ
nano	0.000000001 or 10^{-9}	n
pico	0.000000000001 or 10^{-12}	p
femto	0.000000000000001 or 10^{-15}	f
atto	0.000000000000000001 or 10^{-18}	a

Table B-2. Approximate Conversion Factors for Selected SI (Metric) Units

Multiply SI (Metric) Unit	by	to Obtain US Customary Unit
celsius (°C)	9/5 + 32	fahrenheit (°F)
centimeters (cm)	0.39	inches (in.)
cubic meters (m^3)	35.3	cubic feet (ft^3)
hectares (ha)	2.47	acres
grams (g)	0.035	ounces (oz)
kilograms (kg)	2.2	pounds (lb)
kilometers (km)	0.62	miles (mi)
liters (L)	0.26	gallons (gal.)
meters (m)	3.28	feet (ft)
micrograms per gram (µg/g)	1	parts per million (ppm)
milligrams per liter (mg/L)	1	parts per million (ppm)
square kilometers (km^2)	0.386	square miles (mi^2)

Table B-3. Common Measurement Abbreviations and Measurement Symbols

aCi	attocurie
Bq	becquerel
Btu/yr	British thermal unit per year
Ci	curie
cm^3/s	cubic centimeters per second
cpm/L	counts per minute per liter
fCi/g	femtocurie per gram
ft	foot
ft^3/min	cubic feet per minute
ft^3/s	cubic feet per second
kg	kilogram
kg/h	kilogram per hour
lb/h	pound per hour
lin ft	linear feet
m^3/s	cubic meter per second
µCi/L	microcurie per liter
µCi/mL	microcurie per milliliter
µg/g	microgram per gram
µg/m^3	microgram per cubic meter
mL	milliliter
mm	millimeter
µm	micrometer
µmho/cm	micro mho per centimeter
mCi	millicurie
mg	milligram
mR	milliroentgen

Table B-3. Common Measurement Abbreviations and Measurement Symbols (Cont.)

m/s	meters per second
mrad	millirad
mrem	millirem
mSv	millisievert
nCi	nanocurie
nCi/dry g	nanocurie per dry gram
nCi/L	nanocurie per liter
ng/m^3	nanogram per cubic meter
pCi/dry g	picocurie per dry gram
pCi/g	picocurie per gram
pCi/L	picocurie per liter
pCi/m^3	picocurie per cubic meter
pCi/mL	picocurie per milliliter
pg/g	picogram per gram
pg/m^3	picogram per cubic meter
PM_{10}	small particulate matter (less than 10 µm diameter)
$PM_{2.5}$	small particulate matter (less than 2.5 µm diameter)
R	roentgen
s, ST or σ	standard deviation
s.u.	standard unit
sq ft (ft^2)	square feet
TU	tritium unit
>	greater than
<	less than
≥	greater than or equal to
≤	less than or equal to
±	plus or minus
~	approximately

Reference

Gilbert 1975: R. O. Gilbert, “Recommendations Concerning the Computation and Reporting of Counting Statistics for the Nevada Applied Ecology Group,” Batelle Pacific Northwest Laboratories report BNWL-B-368 (September 1975).

Description of Technical Areas and Their Associated Programs

Locations of the technical areas (TAs) operated by the Laboratory in Los Alamos County are shown in Figure 1-2. The main programs conducted at each of the areas are listed in this Appendix.

TA-0: The Laboratory has about 180,000 sq ft of leased space for training, support, architectural engineering design, and unclassified research and development in the Los Alamos townsite and White Rock. The publicly accessible Community Reading Room and the Bradbury Science Museum are also located in the Los Alamos townsite.

TA-2, Omega Site: Omega West Reactor, an 8-MW nuclear research reactor, is located here. It was placed into a safe shutdown condition in 1993 and was removed from the nuclear facilities list. The reactor will be transferred to the institution for placement into the decontamination and decommissioning (D&D) program beginning in 2006.

TA-3, Core Area: The Administration Complex contains the Director's office, administrative offices, and support facilities. Laboratories for several divisions are in this main TA of the Laboratory. Other buildings house central computing facilities, chemistry and materials science laboratories, earth and space science laboratories, physics laboratories, technical shops, cryogenics laboratories, the main cafeteria, and the Study Center. TA-3 contains about 50% of the Laboratory's employees and floor space.

TA-5, Beta Site: This site contains some physical support facilities such as an electrical substation, test wells, several archaeological sites, and environmental monitoring and buffer areas.

TA-6, Two-Mile Mesa Site: The site is mostly undeveloped and contains gas cylinder staging and vacant buildings pending disposal.

TA-8, GT Site (or Anchor Site West): This is a dynamic testing site operated as a service facility for the entire Laboratory. It maintains capability in all modern nondestructive testing techniques for ensuring quality of material, ranging from test weapons components to high-pressure dies and molds. Principal tools include radiographic techniques (x-ray machines with potentials up to 1,000,000 V and a 24-MeV betatron), radioisotope techniques, ultrasonic and penetrant testing, and electromagnetic test methods.

TA-9, Anchor Site East: At this site, fabrication feasibility and physical properties of explosives are explored. New organic compounds are investigated for possible use as explosives. Storage and stability problems are also studied.

TA-11, K Site: Facilities are located here for testing explosives components and systems, including vibration testing and drop testing, under a variety of extreme physical environments. The facilities are arranged so that testing may be controlled and observed remotely and so that devices containing explosives or radioactive materials, as well as those containing nonhazardous materials, may be tested.

TA-14, Q Site: This dynamic testing site is used for running various tests on relatively small explosive charges for fragment impact tests, explosives sensitivities, and thermal responses.

TA-15, R Site: This is the home of PHERMEX (the pulsed high-energy radiographic machine emitting x-rays), a multiple-cavity electron accelerator capable of producing a very large flux of x-rays for weapons development testing. It is also the site where DARHT (the dual-axis radiographic hydrotest facility) is being constructed. This site is also used for the investigation of weapons functioning and systems behavior in nonnuclear tests, principally through electronic recordings.

TA-16, S Site: Investigations at this site include development, engineering design, prototype manufacture, and environmental testing of nuclear weapons warhead systems. TA-16 is the site of the Weapons Engineering Tritium Facility for tritium handled in gloveboxes. Development and testing of high explosives, plastics, and adhesives and research on process development for manufacture of items using these and other materials are accomplished in extensive facilities.

TA-18, Pajarito Laboratory Site: This is a nuclear facility that studies both static and dynamic behavior of multiplying assemblies of nuclear materials. The Category I quantities of special nuclear materials (SNM) are used to support a wide variety of programs such as Stockpile Management, Stockpile Stewardship, Emergency Response, Nonproliferation, Safeguards, etc. Experiments near critical are operated by remote control using low-power reactors called critical assemblies. The machines are housed in buildings known as kivas and are used primarily to provide a controlled means of assembling a critical amount of fissionable material so that the effects of various shapes, sizes, and configurations can be studied. These machines are also used as a large-quantity source of fission neutrons for experimental purposes. In addition, this facility provides the capability to perform hands-on training and experiments with SNM in various configurations below critical.

TA-21, DP Site: This site has two primary research areas: DP West and DP East. DP West has been in the D&D program since 1992, and six buildings have been demolished. The programs conducted at DP West, primarily in inorganic and biochemistry, were relocated during 1997, and the remainder of the site was scheduled for D&D in future years. DP East is a tritium research site.

TA-22, TD Site: This site is used in the development of special detonators to initiate high-explosive systems. Fundamental and applied research in support of this activity includes investigating phenomena associated with initiating high explosives and research in rapid shock-induced reactions.

TA-28, Magazine Area A: This is an explosives storage area.

TA-33, HP Site: An old, high-pressure, tritium-handling facility located here is being phased out. An intelligence technology group and the National Radio Astronomy Observatory's Very Large Baseline Array Telescope are located at this site.

TA-35, Ten Site: This site is divided into five facility management units. Work here includes nuclear safeguards research and development that are concerned with techniques for nondestructive detection, identification, and analysis of fissionable isotopes. Research is also done on reactor safety, laser fusion, optical sciences, pulsed-power systems, high-energy physics, tritium fabrication, metallurgy, ceramic technology, and chemical plating.

TA-36, Kappa Site: Phenomena of explosives, such as detonation velocity, are investigated at this dynamic testing site.

TA-37, Magazine Area C: This is an explosives storage area.

TA-39, Ancho Canyon Site: The behavior of nonnuclear weapons is studied here, primarily by photographic techniques. Investigations are also made into various phenomenological aspects of explosives, interactions of explosives, explosions involving other materials, shock wave physics, equation state measurements, and pulsed-power systems design.

TA-40, DF Site: This site is used in the development of special detonators to initiate high-explosive systems. Fundamental and applied research in support of this activity includes investigating phenomena associated with the physics of explosives.

TA-41, W Site: Personnel at this site engage primarily in engineering design and development of nuclear components, including fabrication and evaluation of test materials for weapons.

TA-43, Health Research Laboratory: This site is adjacent to the Los Alamos Medical Center in the townsite. Research performed at this site includes structural, molecular, and cellular radiobiology, biophysics, mammalian radiobiology, mammalian metabolism, biochemistry, and genetics. The Department of Energy Los Alamos Area Office is also located within TA-43.

TA-46, WA Site: This TA contains two facility management units. Activities include applied photochemistry research including the development of technology for laser isotope separation and laser enhancement of chemical processes. A new facility completed during 1996 houses research in inorganic and materials chemistry. The Sanitary Wastewater System Facility is located at the east end of this site. Environmental management operations are also located here.

TA-48, Radiochemistry Site: Laboratory scientists and technicians perform research and development (R&D) activities at this site on a wide range of chemical processes including nuclear and radiochemistry, geochemistry, biochemistry, actinide chemistry, and separations chemistry. Hot cells are used to produce medical radioisotopes.

TA-49, Frijoles Mesa Site: This site is currently restricted to carefully selected functions because of its location near Bandelier National Monument and past use in high-explosive and radioactive materials experiments. The Hazardous Devices Team Training Facility is located here.

TA-50, Waste Management Site: This site is divided into two facility management units, which include managing the industrial liquid and radioactive liquid waste received from Laboratory technical areas and activities that are part of the waste treatment technology effort.

TA-51, Environmental Research Site: Research and experimental studies on the long-term impact of radioactive waste on the environment and types of waste storage and coverings are performed at this site.

TA-52, Reactor Development Site: A wide variety of theoretical and computational activities related to nuclear reactor performance and safety are done at this site.

TA-53, Los Alamos Neutron Science Center: The Los Alamos Neutron Science Center, including the linear proton accelerator, the Manuel Lujan Jr. Neutron Scattering Center, and a medical isotope production facility is located at this TA. Also located at TA-53 are the Accelerator Production of Tritium Project Office, including the Low-Energy Demonstration Accelerator, and R&D activities in accelerator technology and high-power microwaves.

TA-54, Waste Disposal Site: This site is divided into two facility management units for the radioactive solid and hazardous chemical waste management and disposal operations and activities that are part of the waste treatment technology effort.

TA-55, Plutonium Facility Site: Processing of plutonium and research on plutonium metallurgy are done at this site.

TA-57, Fenton Hill Site: This site is located about 28 miles west of Los Alamos on the southern edge of the Valles Caldera in the Jemez Mountains and was the location of the Laboratory's now decommissioned Hot Dry Rock geothermal project. The site is used for the testing and development of downhole well-logging instruments and other technologies of interest to the energy industry. The high elevation and remoteness of the site make Fenton Hill a choice location for astrophysics experiments. A gamma ray observatory is located at the site.

TA-58: This site is reserved for multiuse experimental sciences requiring close functional ties to programs currently located at TA-3.

TA-59, Occupational Health Site: Occupational health and safety and environmental management activities are conducted at this site. Emergency management offices are also located here.

TA-60, Sigma Mesa: This area contains physical support and infrastructure facilities, including the Test Fabrication Facility and Rack Assembly and the Alignment Complex.

TA-61, East Jemez Road: This site is used for physical support and infrastructure facilities, including the Los Alamos County sanitary landfill.

TA-62: This site is reserved for multiuse experimental science, public and corporate interface, and environmental research and buffer zones.

TA-63: This is a major growth area at the Laboratory with expanding environmental and waste management functions and facilities. This area contains physical support facilities operated by Johnson Controls Northern New Mexico.

TA-64: This is the site of the Central Guard Facility and headquarters for the Laboratory Hazardous Materials Response Team.

TA-66: This site is used for industrial partnership activities.

TA-67: This is a dynamic testing area that contains significant archeological sites.

TA-68: This is a dynamic testing area that contains archeological and environmental study areas.

TA-69: This undeveloped TA serves as an environmental buffer for the dynamic testing area.

TA-70: This undeveloped TA serves as an environmental buffer for the high-explosives test area.

TA-71: This undeveloped TA serves as an environmental buffer for the high-explosives test area.

TA-72: This is the site of the Protective Forces Training Facility.

TA-73: This area is the Los Alamos Airport.

TA-74, Otowi Tract: This large area, bordering the Pueblo of San Ildefonso on the east, is isolated from most of the Laboratory and contains significant concentrations of archeological sites and an endangered species breeding area. This site also contains Laboratory water wells and future well fields.

Related Websites

For more information on environmental topics at Los Alamos National Laboratory, access the following Web sites:

http://lib-www.lanl.gov/pubs/la-13775.pdf provides access to *Environmental Surveillance at Los Alamos during 1999*.

http://lib-www.lanl.gov/pubs/lalap-00-213.pdf provides access to *Overview of Environmental Surveillance at Los Alamos during 1999*.

http://www.lanl.gov reaches the Los Alamos National Laboratory Web site.

http://www.energy.gov reaches the national Department of Energy Web site.

http://labs.ucop.edu provides information on the three laboratories managed by the University of California.

http://www.esh.lanl.gov/~AirQuality accesses LANL's Air Quality Group.

http://www.esh.lanl.gov/~esh18/ accesses LANL's Water Quality and Hydrology Group.

http://www.esh.lanl.gov/~esh19/ accesses LANL's Hazardous and Solid Waste Group.

http://www.esh.lanl.gov/~esh20/esh20A.html accesses LANL's Ecology Group.

http://erproject.lanl.gov provides information on LANL's Environmental Restoration Project.

activation mixed fission	Activation products are formed when a substance is struck by protons or neutrons. The atoms of the original substance are converted to another element that is unstable and, therefore, radioactive.
activation products	Radioactive products generated as a result of neutrons and other subatomic particles interacting with materials such as air, construction materials, or impurities in cooling water. These activation products are usually distinguished, for reporting purposes, from fission products.
albedo dosimeters	Albedo dosimeters are used to measure neutrons around TA-18. They use a neutron-sensitive polyethylene phantom that is used to capture neutron backscatter to simulate the human body.
alpha particle	A positively charged particle (identical to the helium nucleus) composed of two protons and two neutrons that are emitted during decay of certain radioactive atoms. Alpha particles are stopped by several centimeters of air or a sheet of paper.
ambient air	The surrounding atmosphere as it exists around people, plants, and structures. It is not considered to include the air immediately adjacent to emission sources.
aquifer	A saturated layer of rock or soil below the ground surface that can supply usable quantities of groundwater to wells and springs. Aquifers can be a source of water for domestic, agricultural, and industrial uses.
artesian well	A well in which the water rises above the top of the water-bearing bed.
background radiation	Ionizing radiation from sources other than the Laboratory. This radiation may include cosmic radiation; external radiation from naturally occurring radioactivity in the earth (terrestrial radiation), air, and water; internal radiation from naturally occurring radioactive elements in the human body; worldwide fallout; and radiation from medical diagnostic procedures.
beta particle	A negatively charged particle (identical to the electron) that is emitted during decay of certain radioactive atoms. Most beta particles are stopped by 0.6 cm of aluminum.
biota	The types of animal and plant life found in an area.
blank sample	A control sample that is identical, in principle, to the sample of interest, except that the substance being analyzed is absent. The measured value or signals in blanks for the analyte is believed to be caused by artifacts and should be subtracted from the measured value. This process yields a net amount of the substance in the sample.
blind sample	A control sample of known concentration in which the expected values of the constituent are unknown to the analyst.
BOD	Biochemical (biological) oxygen demand. A measure of the amount of oxygen in biological processes that breaks down organic matter in water; a measure of the organic pollutant load. It is used as an indicator of water quality.

CAA	Clean Air Act. The federal law that authorizes the Environmental Protection Agency (EPA) to set air quality standards and to assist state and local governments to develop and execute air pollution prevention and control programs.
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980. Also known as Superfund, this law authorizes the federal government to respond directly to releases of hazardous substances that may endanger health or the environment. The EPA is responsible for managing Superfund.
CFR	Code of Federal Regulations. A codification of all regulations developed and finalized by federal agencies in the *Federal Register*.
COC	Chain-of-Custody. A method for documenting the history and possession of a sample from the time of collection, through analysis and data reporting, to its final disposition.
contamination	(1) Substances introduced into the environment as a result of people's activities, regardless of whether the concentration is a threat to health (see pollution). (2) The deposition of unwanted radioactive material on the surfaces of structures, areas, objects, or personnel.
controlled area	Any Laboratory area to which access is controlled to protect individuals from exposure to radiation and radioactive materials.
Ci	Curie. Unit of radioactivity. One Ci equals 3.70×10^{10} nuclear transformations per second.
cosmic radiation	High-energy particulate and electromagnetic radiations that originate outside the earth's atmosphere. Cosmic radiation is part of natural background radiation.
CWA	Clean Water Act. The federal law that authorizes the EPA to set standards designed to restore and maintain the chemical, physical, and biological integrity of the nation's waters.
DOE	US Department of Energy. The federal agency that sponsors energy research and regulates nuclear materials used for weapons production.
dose	A term denoting the quantity of radiation energy absorbed.
EDE	Effective dose equivalent. The hypothetical whole-body dose that would give the same risk of cancer mortality and serious genetic disorder as a given exposure but that may be limited to a few organs. The effective dose equivalent is equal to the sum of individual organ doses, each weighted by degree of risk that the organ dose carries. For example, a 100-mrem dose to the lung, which has a weighting factor of 0.12, gives an effective dose that is equivalent to $100 \times 0.12 = 12$ mrem. CEDE: committed effective dose equivalent TEDE: total effective dose equivalent

maximum individual dose	The greatest dose commitment, considering all potential routes of exposure from a facility's operation, to an individual at or outside the Laboratory boundary where the highest dose rate occurs. It takes into account shielding and occupancy factors that would apply to a real individual.
population dose	The sum of the radiation doses to individuals of a population. It is expressed in units of person-rem. (For example, if 1,000 people each received a radiation dose of 1 rem, their population dose would be 1,000 person-rem.)
whole body dose	A radiation dose commitment that involves exposure of the entire body (as opposed to an organ dose that involves exposure to a single organ or set of organs).
EA	Environmental Assessment. A report that identifies potentially significant environmental impacts from any federally approved or funded project that may change the physical environment. If an EA shows significant impact, an Environmental Impact Statement is required.
effluent	A liquid waste discharged to the environment.
EIS	Environmental Impact Statement. A detailed report, required by federal law, on the significant environmental impacts that a proposed major federal action would have on the environment. An EIS must be prepared by a government agency when a major federal action that will have significant environmental impacts is planned.
emission	A gaseous waste discharged to the environment.
environmental compliance	The documentation that the Laboratory complies with the multiple federal and state environmental statutes, regulations, and permits that are designed to ensure environmental protection. This documentation is based on the results of the Laboratory's environmental monitoring and surveillance programs.
environmental monitoring	The sampling of contaminants in liquid effluents and gaseous emissions from Laboratory facilities, either by directly measuring or by collecting and analyzing samples in a laboratory.
environmental surveillance	The sampling of contaminants in air, water, sediments, soils, food-stuffs, and plants and animals, either by directly measuring or by collecting and analyzing samples in a laboratory.
EPA	Environmental Protection Agency. The federal agency responsible for enforcing environmental laws. Although state regulatory agencies may be authorized to administer some of this responsibility, EPA retains oversight authority to ensure protection of human health and the environment.
exposure	A measure of the ionization produced in air by x-ray or gamma ray radiation. (The unit of exposure is the roentgen.)

external radiation	Radiation originating from a source outside the body.
gallery	An underground collection basin for spring discharges.
gamma radiation	Short-wavelength electromagnetic radiation of nuclear origin that has no mass or charge. Because of its short wavelength (high energy), gamma radiation can cause ionization. Other electromagnetic radiation (such as microwaves, visible light, and radiowaves) has longer wavelengths (lower energy) and cannot cause ionization.
GENII	Computer code used to calculate doses from all pathways (air, water, foodstuffs, and soil).
gross alpha	The total amount of measured alpha activity without identification of specific radionuclides.
gross beta	The total amount of measured beta activity without identification of specific radionuclides.
groundwater	Water found beneath the surface of the ground. Groundwater usually refers to a zone of complete water saturation containing no air.
^{3}H	Tritium.
half-life, radioactive	The time required for the activity of a radioactive substance to decrease to half its value by inherent radioactive decay. After two half-lives, one-fourth of the original activity remains ($1/2 \times 1/2$), after three half-lives, one-eighth ($1/2 \times 1/2 \times 1/2$), and so on.
hazardous waste	Wastes exhibiting any of the following characteristics: ignitability, corrosivity, reactivity, or yielding toxic constituents in a leaching test. In addition, EPA has listed as hazardous other wastes that do not necessarily exhibit these characteristics. Although the legal definition of hazardous waste is complex, the term generally refers to any waste that EPA believes could pose a threat to human health and the environment if managed improperly. Resource Conservation and Recovery Act (RCRA) regulations set strict controls on the management of hazardous wastes.
hazardous waste constituent	The specific substance in a hazardous waste that makes it hazardous and therefore subject to regulation under Subtitle C of RCRA.
HSWA	Hazardous and Solid Waste Amendments of 1984 to RCRA. These amendments to RCRA greatly expanded the scope of hazardous waste regulation. In HSWA, Congress directed EPA to take measures to further reduce the risks to human health and the environment caused by hazardous wastes.
hydrology	The science dealing with the properties, distribution, and circulation of natural water systems.
internal radiation	Radiation from a source within the body as a result of deposition of radionuclides in body tissues by processes such as ingestion, inhalation, or implantation. Potassium-40, a naturally occurring radionuclide, is a major source of internal radiation in living organisms. Also called self-irradiation.

ionizing radiation Radiation possessing enough energy to remove electrons from the substances through which it passes. The primary contributors to ionizing radiation are radon, cosmic and terrestrial sources, and medical sources such as x-rays and other diagnostic exposures.

isotopes Forms of an element having the same number of protons in their nuclei but differing in the number of neutrons. Isotopes of an element have similar chemical behaviors but can have different nuclear behaviors.

- long-lived isotope - A radionuclide that decays at such a slow rate that a quantity of it will exist for an extended period (half-life is greater than three years).
- short-lived isotope - A radionuclide that decays so rapidly that a given quantity is transformed almost completely into decay products within a short period (half-life is two days or less).

LLW Low-level waste. The level of radioactive contamination in LLW is not strictly defined. Rather, LLW is defined by what it is not. It does not include nuclear fuel rods, wastes from processing nuclear fuels, transuranic (TRU) waste, or uranium mill tailings.

MCL Maximum contaminant level. Maximum permissible level of a contaminant in water that is delivered to the free-flowing outlet of the ultimate user of a public water system (see Appendix A and Table A-6). The MCLs are specified by the EPA.

MEI Maximally exposed individual. The average exposure to the population in general will always be less than to one person or subset of persons because of where they live, what they do, and their individual habits. To try to estimate the dose to the MEI, one tries to find that population subgroup (and more specifically, the one individual) that potentially has the highest exposure, intake, etc. This becomes the MEI.

mixed waste Waste that contains a hazardous waste component regulated under Subtitle C of the RCRA and a radioactive component consisting of source, special nuclear, or byproduct material regulated under the federal Atomic Energy Act (AEA).

mrem Millirem. See definition of rem. The dose equivalent that is one-thousandth of a rem.

NEPA National Environmental Policy Act. This federal legislation, passed in 1969, requires federal agencies to evaluate the impacts of their proposed actions on the environment before decision making. One provision of NEPA requires the preparation of an EIS by federal agencies when major actions significantly affecting the quality of the human environment are proposed.

NESHAP National Emission Standards for Hazardous Air Pollutants. These standards are found in the CAA; they set limits for such pollutants as beryllium and radionuclides.

nonhazardous waste	Chemical waste regulated under the Solid Waste Act, Toxic Substances Control Act, and other regulations, including asbestos, PCB, infectious wastes, and other materials that are controlled for reasons of health, safety, and security.
NPDES	National Pollutant Discharge Elimination System. This federal program, under the Clean Water Act, requires permits for discharges into surface waterways.
nuclide	A species of atom characterized by the constitution of its nucleus. The nuclear constitution is specified by the number of protons, number of neutrons, and energy content—or alternately, by the atomic number, mass number, and atomic mass. To be a distinct nuclide, the atom must be capable of existing for a measurable length of time.
outfall	The location where wastewater is released from a point source into a receiving body of water.
PCB	Polychlorinated biphenyls. A family of organic compounds used since 1926 in electric transformers, lubricants, carbonless copy paper, adhesives, and caulking compounds. PCB are extremely persistent in the environment because they do not break down into new and less harmful chemicals. PCB are stored in the fatty tissues of humans and animals through the bioaccumulation process. EPA banned the use of PCB, with limited exceptions, in 1976.
PDL	Public Dose Limit. The new term for Radiation Protection Standards, a standard for external and internal exposure to radioactivity as defined in DOE Order 5400.5 (see Appendix A and Table A-1).
perched groundwater	A groundwater body above a slow-permeablity rock or soil layer that is separated from an underlying main body of groundwater by a vadose zone.
person-rem	A quantity used to describe the radiological dose to a population. Population doses are calculated according to sectors, and all people in a sector are assumed to get the same dose. The number of person-rem is calculated by summing the modeled dose to all receptors in all sectors. Therefore, person-rem is the sum of the number of people times the dose they receive.
pH	A measure of the hydrogen ion concentration in an aqueous solution. Acidic solutions have a pH less than 7, basic solutions have a pH greater than 7, and neutral solutions have a pH of 7.
pollution	Levels of contamination that may be objectionable (perhaps because of a threat to health [see contamination]).
point source	An identifiable and confined discharge point for one or more water pollutants, such as a pipe, channel, vessel, or ditch.
ppb	Parts per billion. A unit measure of concentration equivalent to the weight/volume ratio expressed as µg/L or ng/mL. Also used to express the weight/weight ratio as ng/g or µg/kg.

ppm Parts per million. A unit measure of concentration equivalent to the weight/volume ratio expressed as mg/L. Also used to express the weight/weight ratio as µg/g or mg/kg.

QA Quality assurance. Any action in environmental monitoring to ensure the reliability of monitoring and measurement data. Aspects of quality assurance include procedures, interlaboratory comparison studies, evaluations, and documentation.

QC Quality control. The routine application of procedures within environmental monitoring to obtain the required standards of performance in monitoring and measurement processes. QC procedures include calibration of instruments, control charts, and analysis of replicate and duplicate samples.

rad Radiation absorbed dose. The rad is a unit for measuring energy absorbed in any material. Absorbed dose results from energy being deposited by the radiation. It is defined for any material. It applies to all types of radiation and does not take into account the potential effect that different types of radiation have on the body.

1 rad = 1,000 millirad (mrad)

radionuclide An unstable nuclide capable of spontaneous transformation into other nuclides through changes in its nuclear configuration or energy level. This transformation is accompanied by the emission of photons or particles.

RESRAD A computer modeling code designed to model radionuclide transport in the environment.

RCRA Resource Conservation and Recovery Act of 1976. RCRA is an amendment to the first federal solid waste legislation, the Solid Waste Disposal Act of 1965. In RCRA, Congress established initial directives and guidelines for EPA to regulate hazardous wastes.

release Any discharge to the environment. Environment is broadly defined as water, land, or ambient air.

rem Roentgen equivalent man. The rem is a unit for measuring dose equivalence. It is the most commonly used unit and pertains only to people. The rem takes into account the energy absorbed (dose) and the biological effect on the body (quality factor) from the different types of radiation.

rem = rad × quality factor
1 rem = 1,000 millirem (mrem)

SAL Screening Action Limit. A defined contaminant level that if exceeded in a sample requires further action.

SARA Superfund Amendments and Reauthorization Act of 1986. This act modifies and reauthorizes CERCLA. Title III of this act is known as the Emergency Planning and Community Right-to-Know Act of 1986.

saturated zone	Rock or soil where the pores are completely filled with water, and no air is present.
SWMU	Solid waste management unit. Any discernible site at which solid wastes have been placed at any time, regardless of whether the unit was intended for the management of solid or hazardous waste. Such units include any area at or around a facility at which solid wastes have been routinely and systematically released, such as waste tanks, septic tanks, firing sites, burn pits, sumps, landfills (material disposal areas), outfall areas, canyons around LANL, and contaminated areas resulting from leaking product storage tanks (including petroleum).
terrestrial radiation	Radiation emitted by naturally occurring radionuclides such as internal radiation source; the natural decay chains of uranium-235, uranium-238, or thorium-232; or cosmic-ray-induced radionuclides in the soil.
TLD	Thermoluminescent dosimeter. A material (the Laboratory uses lithium fluoride) that emits a light signal when heated to approximately 300°C. This light is proportional to the amount of radiation (dose) to which the dosimeter was exposed.
TRU	Transuranic waste. Waste contaminated with long-lived transuranic elements in concentrations within a specified range established by DOE, EPA, and Nuclear Regulatory Agency. These are elements shown above uranium on the chemistry periodic table, such as plutonium, americium, and neptunium, that have activities greater than 100 nanocuries per gram.
TSCA	Toxic Substances Control Act. TSCA is intended to provide protection from substances manufactured, processed, distributed, or used in the United States. A mechanism is required by the act for screening new substances before they enter the marketplace and for testing existing substances that are suspected of creating health hazards. Specific regulations may also be promulgated under this act for controlling substances found to be detrimental to human health or to the environment.
tuff	Rock formed from compacted volcanic ash fragments.
uncontrolled area	An area beyond the boundaries of a controlled area (see controlled area in this glossary).
unsaturated zone	See vadose zone in this glossary.
UST	Underground storage tank. A stationary device, constructed primarily of nonearthen material, designed to contain petroleum products or hazardous materials. In a UST, 10% or more of the volume of the tank system is below the surface of the ground.
vadose zone	The partially saturated or unsaturated region above the water table that does not yield water for wells. Water in the vadose zone is held to rock

	or soil particles by capillary forces and much of the pore space is filled with air.
water table	The water level surface below the ground at which the unsaturated zone ends and the saturated zone begins. It is the level to which a well that is screened in the unconfined aquifer would fill with water.
water year	October through September.
watershed	The region draining into a river, a river system, or a body of water.
wetland	A lowland area, such as a marsh or swamp, that is inundated or saturated by surface water or groundwater sufficient to support hydrophytic vegetation typically adapted for life in saturated soils.
wind rose	A diagram that shows the frequency and intensity of wind from different directions at a particular place.
worldwide fallout	Radioactive debris from atmospheric weapons tests that has been deposited on the earth's surface after being airborne and cycling around the earth.

AA-2	Internal Assessment Group (LANL)
AEC	Atomic Energy Commission
AIP	Agreement in Principle
AIRFA	American Indian Religious Freedom Act
AIRNET	Air Monitoring Network
AL	Albuquerque Operations Office (DOE)
AO	Administrative Order
AQCR	Air Quality Control Regulation (New Mexico)
ARPA	Archeological Resources Protection Act
BEIR	biological effects of ionizing radiation
BOD	biochemical/biological oxygen demand
BTEX	total aromatic hydrocarbon
Btu	British thermal unit
CAA	Clean Air Act
CAS	Connected Action Statement
CCNS	Concerned Citizens for Nuclear Safety
CEDE	committed effective dose equivalent
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CIO	Community Involvement Office (LANL)
CMR	Chemistry and Metallurgy Research (LANL building)
CO	compliance order
COC	chain-of-custody
COD	chemical oxygen demand
COE	Army Corps of Engineers
CST	Chemical Sciences and Technology (LANL division)
CST-3	Analytical Services Group (LANL)
CST-13	Radioisotopes and Industrial Wastewater Science Group (LANL)
CWA	Clean Water Act
CY	calendar year
DAC	derived air concentration (DOE)
DARHT	Dual Axis Radiographic Hydrotest facility
DCG	Derived Concentration Guide (DOE)
D&D	decontamination and decommissioning
DEC	DOE Environmental Checklist
DOE	Department of Energy
DOE-EM	DOE, Environmental Management
DOU	Document of Understanding
EA	Environmental Assessment
EDE	effective dose equivalent
EIS	Environmental Impact Statement
EML	Environmental Measurements Laboratory
EO	Executive Order
EPA	Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act

Acronyms and Abbreviations

ER	Environmental Restoration
ESH	Environment, Safety, & Health
ESH-4	Health Physics Measurements Group (LANL)
ESH-13	ESH Training Group (LANL)
ESH-14	Quality Assurance Support Group (LANL)
ESH-17	Air Quality Group (LANL)
ESH-18	Water Quality & Hydrology Group (LANL)
ESH-19	Hazardous & Solid Waste Group (LANL)
ESH-20	Ecology Group (LANL)
ESO	Environmental Stewardship Office (LANL)
EST	Ecological Studies Team (ESH-20)
FFCA	Federal Facilities Compliance Agreement
FFCAct	Federal Facilities Compliance Act
FFCAgreement	RCRA Federal Facility Compliance Agreement
FFCO	Federal Facility Compliance Order
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FIMAD	Facility for Information Management, Analysis, and Display
FONSI	Finding of No Significant Impact
FY	fiscal year
GENII	Generation II
GIS	geographic information system
G/MAP	gaseous/mixed air activation products
GPS	global positioning system
GWPMPP	Groundwater Protection Management Program Plan
HAZWOPER	hazardous waste operations (training class)
HE	high-explosive
HEWTP	High-Explosive Wastewater Treatment Plant
HMPT	Hazardous Materials Packaging and Transportation
HPAL	Health Physics Analytical Laboratory
HSWA	Hazardous and Solid Waste Amendments
HWA	Hazardous Waste Act (New Mexico)
HWMR	Hazardous Waste Management Regulations (New Mexico)
ICRP	International Commission on Radiological Protection
JCNNM	Johnson Controls Northern New Mexico
JENV	JCNM Environmental Laboratory
LAAO	Los Alamos Area Office (DOE)
LANSCE	Los Alamos Neutron Science Center
LANL	Los Alamos National Laboratory (or the Laboratory)
LEDA	Low-Energy Demonstration Accelerator
LLW	low-level radioactive waste
LLMW	low-level mixed waste
LOQ	limit of quantitation
MAP	Mitigation Action Plan
MCL	maximum contaminant level
MDA	minimum detectable amount

MEI	maximally exposed individual
NAGPRA	Native American Grave Protection and Repatriation Act
NCRP	National Council on Radiation Protection and Measurements
NEPA	National Environmental Policy Act
NERF	NEPA Review Form
NESHAP	National Emission Standards for Hazardous Air Pollutants
NEWNET	Neighborhood Environmental Watch Network
NHPA	National Historic Preservation Act
NMDA	New Mexico Department of Agriculture
NMED	New Mexico Environment Department
NMEIB	New Mexico Environmental Improvement Board
NMWQCA	New Mexico Water Quality Control Act
NMWQCC	New Mexico Water Quality Control Commission
NPDES	National Pollutant Discharge Elimination System
NRC	US Nuclear Regulatory Commission
OB/OD	open burning/open detonation
ODS	ozone depleting substance
O&G	oil and grease
OHL	Occupational Health Laboratory (LANL)
OSHA	Occupational Safety and Health Act/Administration
PCB	polychlorinated biphenyls
PDL	public dose limit
PHERMEX	Pulsed high-energy radiographic machine emitting x-rays
ppb	parts per billion
ppm	parts per million
QA	quality assurance
QAP	Quality Assurance Program
QC	quality control
RCRA	Resource Conservation and Recovery Act
RD&D	research, development, and demonstration
RESRAD	residual radioactive material computer code
RLWTF	Radioactive Liquid Waste Treatment Facility (LANL)
RSRL	regional statistical reference level
SAL	screening action level
SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
SHPO	State Historic Preservation Officer (New Mexico)
SLD	Scientific Laboratory Division (New Mexico)
SOC	synthetic organic compound
SPCC	Spill Prevention Control and Countermeasures
SVOC	semivolatile organic compound
SWA	Solid Waste Act
SWPP	Storm Water Prevention Plan
SWMR	solid waste management regulations
SWMU	solid waste management unit

SWSC	Sanitary Wastewater Systems Consolidation Plant (LANL)
TA	Technical Area
TDS	total dissolved solids
TEDE	total effective dose equivalent
TLD	thermoluminescent dosimeter
TLDNET	thermoluminescent dosimeter network
TRI	toxic chemical release inventory
TRU	transuranic waste
TRPH	total recoverable petroleum hydrocarbon
TSCA	Toxic Substances Control Act
TSS	total suspended solids
TTHM	trihalomethane
TWISP	Transuranic Waste Inspectable Storage Project (LANL)
UC	University of California
USFS	United States Forest Service
USGS	United States Geological Survey
UST	underground storage tank
VAP	vaporous activation products
VOC	volatile organic compound
WASTENET	Waste Management Areas Network (for air monitoring)
WM	Waste Management (LANL)
WSC	Waste Stream Characterization
WWW	World Wide Web

Elemental and Chemical Nomenclature

Actinium	Ac	Molybdenum	Mo
Aluminum	Al	Neodymium	Nd
Americium	Am	Neon	Ne
Argon	Ar	Neptunium	Np
Antimony	Sb	Nickel	Ni
Arsenic	As	Niobium	Nb
Astatine	At	Nitrate (as Nitrogen)	NO_3-N
Barium	Ba	Nitrite (as Nitrogen)	NO_2-N
Berkelium	Bk	Nitrogen	N
Beryllium	Be	Nitrogen dioxide	NO_2
Bicarbonate	HCO_3	Nobelium	No
Bismuth	Bi	Osmium	Os
Boron	B	Oxygen	O
Bromine	Br	Palladium	Pd
Cadmium	Cd	Phosphaeus	P
Calcium	Ca	Phosphate (as Phosphous)	PO_4-P
Californium	Cf	Platinum	Pt
Carbon	C	Plutonium	Pu
Cerium	Ce	Polonium	Po
Cesium	Cs	Potassium	K
Chlorine	Cl	Praseodymium	Pr
Chromium	Cr	Promethium	Pm
Cobalt	Co	Protactinium	Pa
Copper	Cu	Radium	Ra
Curium	Cm	Radon	Rn
Cyanide	CN	Rhenium	Re
Carbonate	CO_3	Rhodium	Rh
Dysprosium	Dy	Rubidium	Rb
Einsteinium	Es	Ruthenium	Ru
Erbium	Er	Samarium	Sm
Europium	Eu	Scandium	Sc
Fermium	Fm	Selenium	Se
Fluorine	F	Silicon	Si
Francium	Fr	Silver	Ag
Gadolinium	Gd	Sodium	Na
Gallium	Ga	Stronium	Sr
Germanium	Ge	Sulfate	SO_4
Gold	Au	Sulfite	SO_3
Hafnium	Hf	Sulfur	S
Helium	He	Tantalum	Ta
Holmium	Ho	Technetium	Tc
Hydrogen	H	Tellurium	Te
Hydrogen oxide	H_2O	Terbium	Tb
Indium	In	Thallium	Tl
Iodine	I	Thorium	Th
Iridium	Ir	Thulium	Tm
Iron	Fe	Tin	Sn
Krypton	Kr	Titanium	Ti
Lanthanum	La	Tritiated water	HTO
Lawrencium	Lr (Lw)	Tritium	^3H
Lead	Pb	Tungsten	W
Lithium	Li	Uranium	U
Lithium fluoride	LiF	Vanadium	V
Lutetium	Lu	Xenon	Xe
Magnesium	Mg	Ytterbium	Yb
Manganese	Mn	Yttrium	Y
Mendelevium	Md	Zinc	Zn
Mercury	Hg	Zirconium	Zr

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Group ESH-19, Hazardous and Solid Waste
Group ESH-20, Ecology Group
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Previous reports in this series are LA-13047-ENV, LA-13210-ENV, LA-13343-ENV, LA-13487-ENV, and LA-13633-ENV.

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Printing coordination, Lupe Archuleta

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